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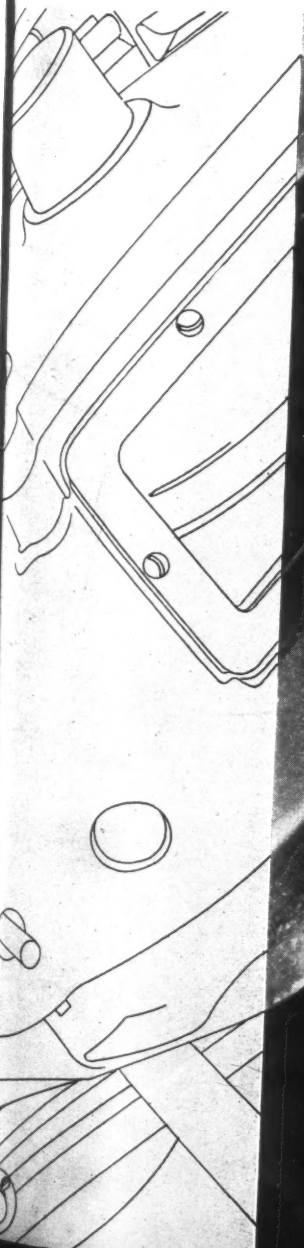
MACHINE DESIGN

October 1943



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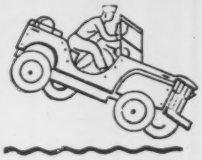

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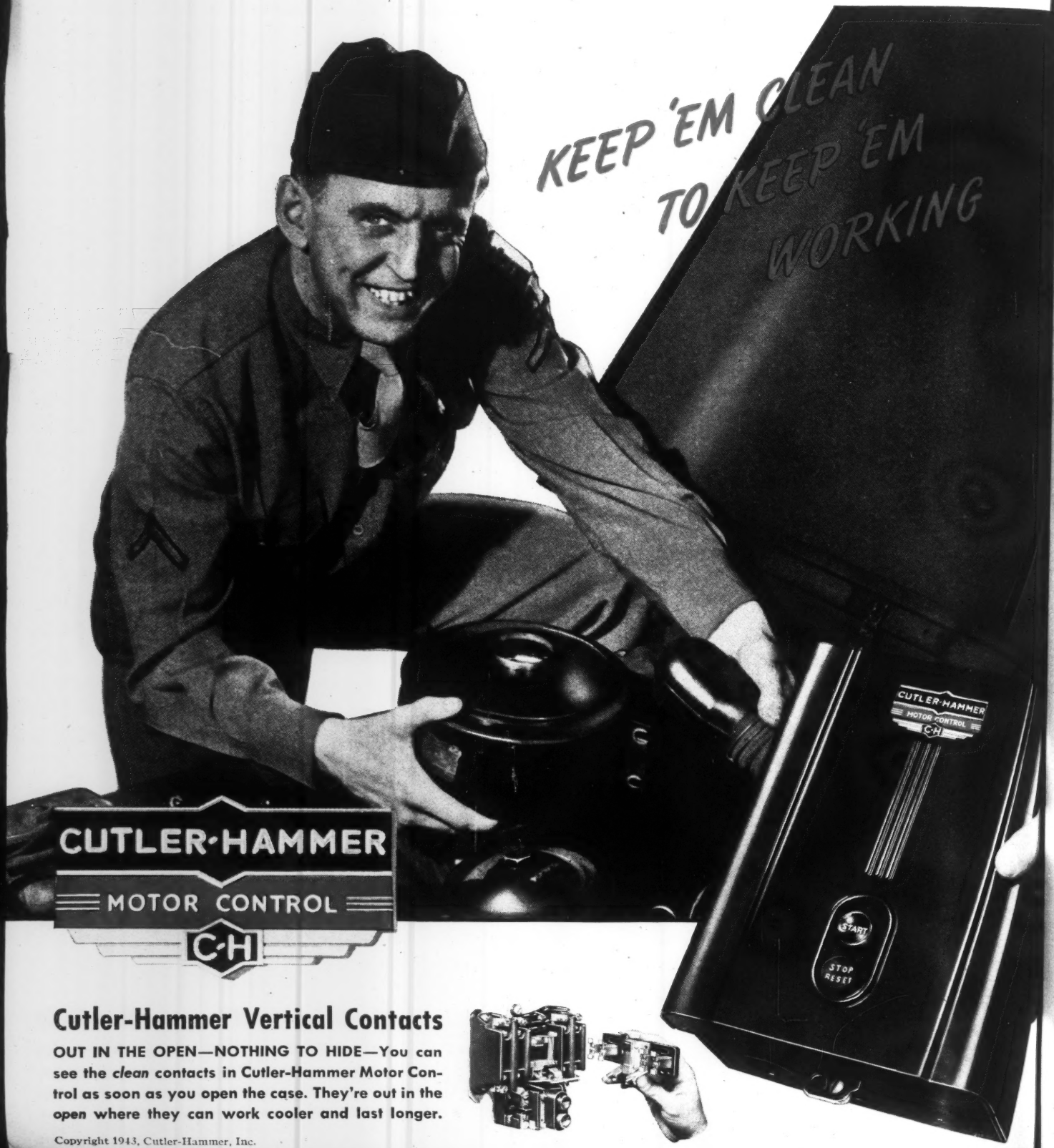

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THE PROFESSIONAL JOURNAL OF CHIEF ENGINEERS AND DESIGNERS

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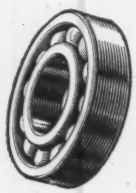

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THE FORGED STEEL BEARING

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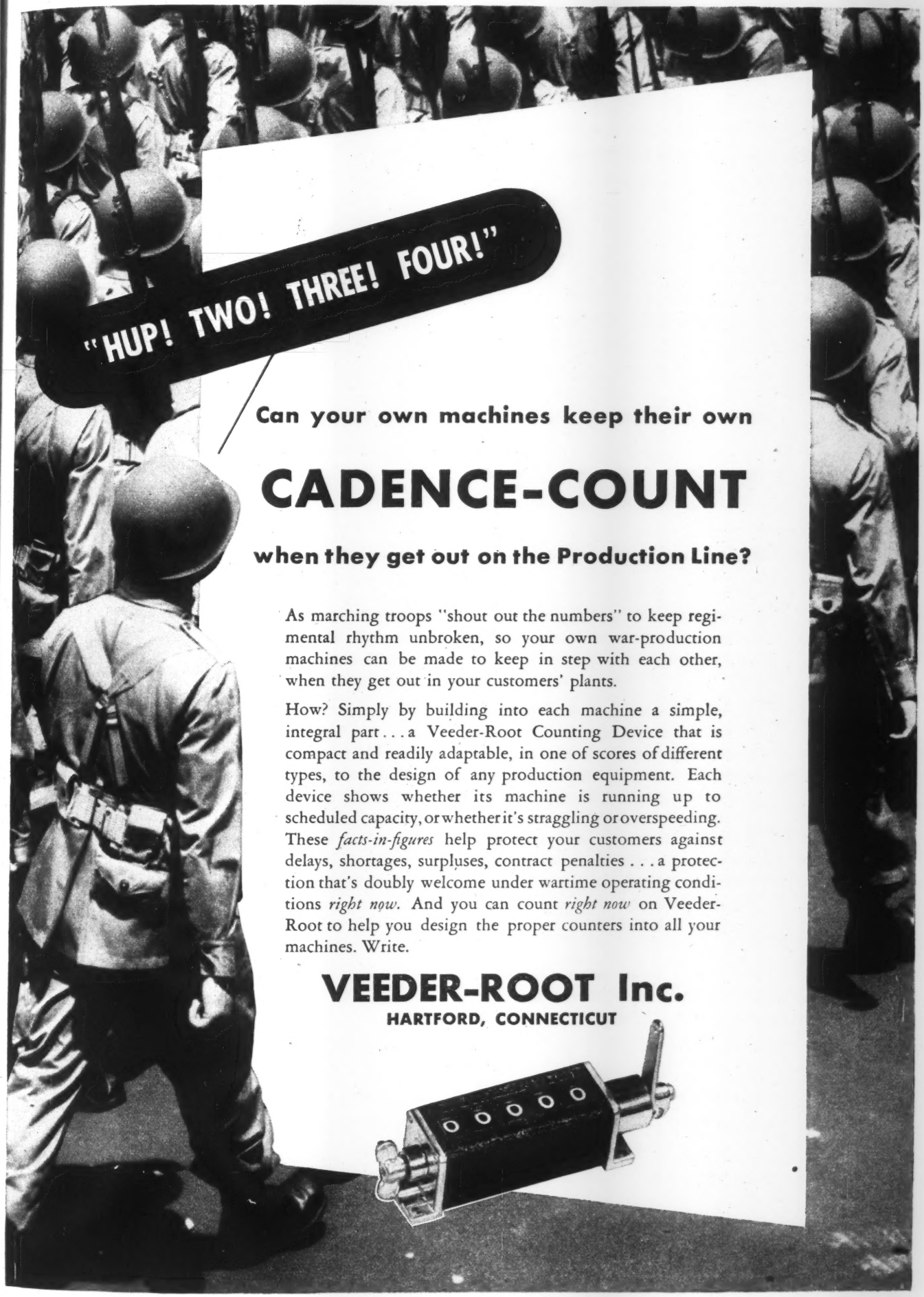

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Topics

MAGNITUDE of the government's stake in manufacturing plants and industrial facilities is amazingly large. At the end of the war, the government may own as much as ten per cent of the steel industry, a larger aluminum producing capacity than all private aluminum production, ninety-two per cent of the total magnesium capacity, practically two-thirds of the synthetic rubber capacity, practically one-half of the machine tool building facilities, and ten times the amount of privately owned industry in aviation.

IRON SEA HORSES of the type which first powered American fighting vessels in the Spanish-American war are now being used in the Navy's swift new destroyer escort vessels. Called "iron sea horses" because of their toughness and adaptability, they meet every test of modern sub warfare although the design of these triple-expansion steam engines is basically the same as the first models which were developed in England in the nineties.

BUICK production of Consolidated B-24 Liberator bomber engines will be 36 per cent higher for the fourth quarter than for the third and three times the volume of the first. Total volume for the year will triple that of the previous year.

TRIPLE-DECK pullman sleepers for troops, designed to accommodate 30 men, are being built by Pullman-Standard Car Mfg. Co. and incorporate the use of noncritical materials wherever possible. Having a side aisle and center-side entrance, thus resembling continental coaches, the design envisions reduced sleeping-rate cars after the war.

INFRARED identification on employees hands, in much the same manner that laundries mark customers' wash, aids plant guards and eliminates troubles associated with badges. Invisible except under infrared light, the marking is of no inconvenience to the worker and lasts through many hand washings.

RADIO NAILING for tacking plywoods, plastics and other industrial materials obviates the customary tedious and time-consuming procedure of using metal fasteners, tacks or staples. Developed by RCA the "radio nail" is a discharge of high-frequency electric current through a gun, generating a quick and intense heat to spot-glue thin sheets of material having a coating of plastic glue between them. The gun resembles a short-barreled automatic pistol and is attached to a portable high-frequency generator. Maneuverability is enhanced by locating both electrodes in the muzzle of the gun, the barrel being one and a pin in the center of the bore being the other. Because the material to be bonded is a better conductor than the air between the pin and the muzzle, the current flows in a curved line through the material. An automatic timer is incorporated in the gun to provide the exact amount of heat needed so that material, when it reaches final assembly, may be adjusted as required before the final bond is made.

COLOR MATCHING with camouflage paints requires that colors not only match in the visible spectrum but also reflect infrared similarly to the natural colors they are designed to simulate. In this way infrared photography would not detect the shape of a camouflaged object. A recording spectrophotometer is of invaluable aid for this purpose, matching colors both in the visible and invisible spectrums. The camouflager is now on an equal footing with the infrared camera, aiding our fighting forces in deceiving enemy observers.

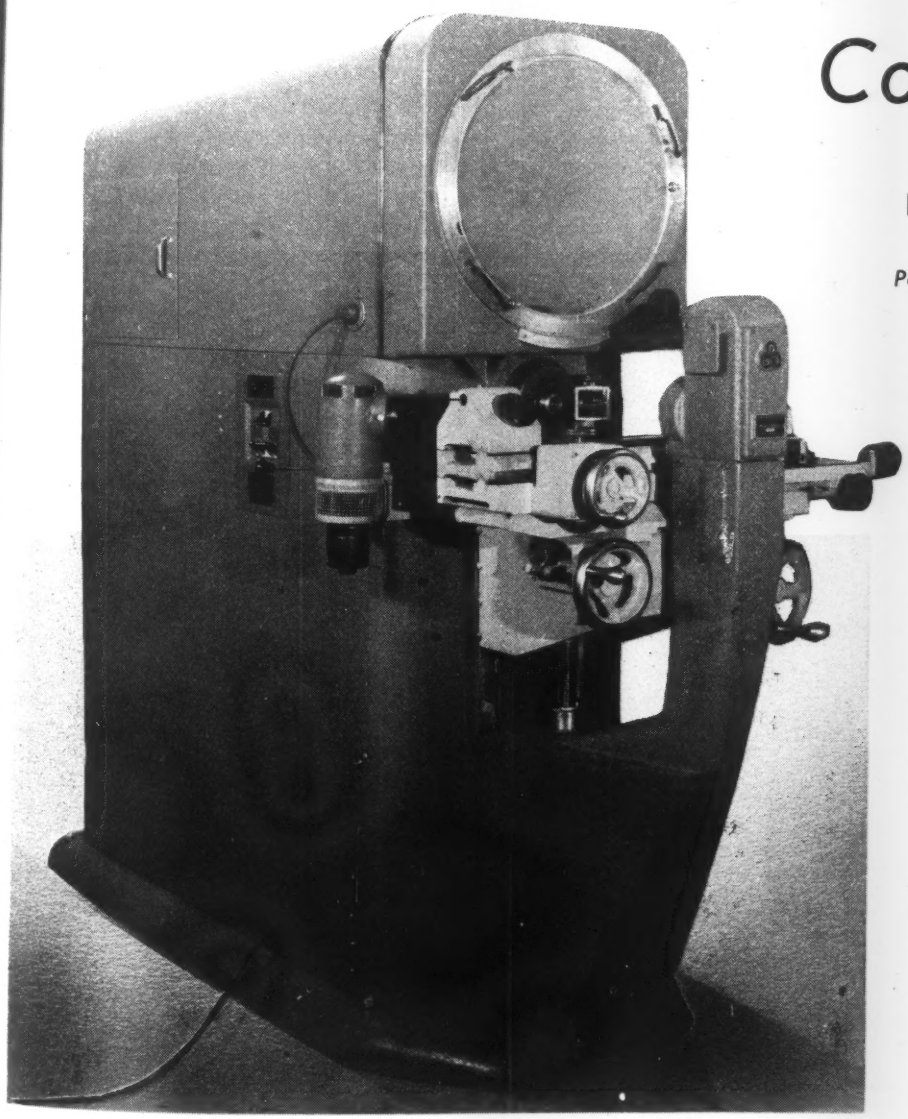
DRAFTSMEN are being sought by the U. S. Civil Service Commission for work in Federal agencies that is necessary to the prosecution of the war. Draftsmen of all types are needed, particularly ship, electrical and mechanical, as well as topographic draftsmen. Qualified engineering draftsmen in any field are urged to apply; women are especially desired. Applicants may secure announcement 283 and forms from post offices, Civil Service regional offices or direct from the Commission in Washington.

RETURNED SOLDIERS having civilian jobs are the best defense against loose talk, absenteeism, slow downs, dissatisfaction and other forms of sabotage. They just won't stand for it. They can talk both the language of the fighter and the workman, making an excellent morale builder.

MACHINE DESIGN

Optical Problems in Design of Comparator

By Frank J. Acton
Chief Engineer
Portman Machine Tool Co.



DEMAND for equipment capable of checking the dimensions of relatively intricate shapes of stamped parts, cutters, special form tools, screw threads, gears, etc., has led to the development of the universal comparator illustrated in *Fig.* 1. Incorporating in its design a number of interesting and unusual features, the machine is capable of handling parts of a size hitherto considered outside the range of optical inspection apparatus.

Because engineers are generally familiar with the purposes of this type of equipment, only brief reference will be made to the uses of the machine. The part to be

Fig. 1—Constructed entirely of noncritical materials, the Portman optical comparator has been designed with a view to operation by semiskilled or unskilled personnel

checked is mounted on a universal stage and its image projected on an 18-inch diameter screen visible in the upper part of the machine, *Fig.* 1. Measurements are made either by placing on the screen a properly enlarged drawing of the part and comparing dimensions, or by moving the part so that its image traverses a distance corresponding to the dimension to be checked, measuring devices attached to the stage determining how far the actual part has moved.

Increased Illumination Needed

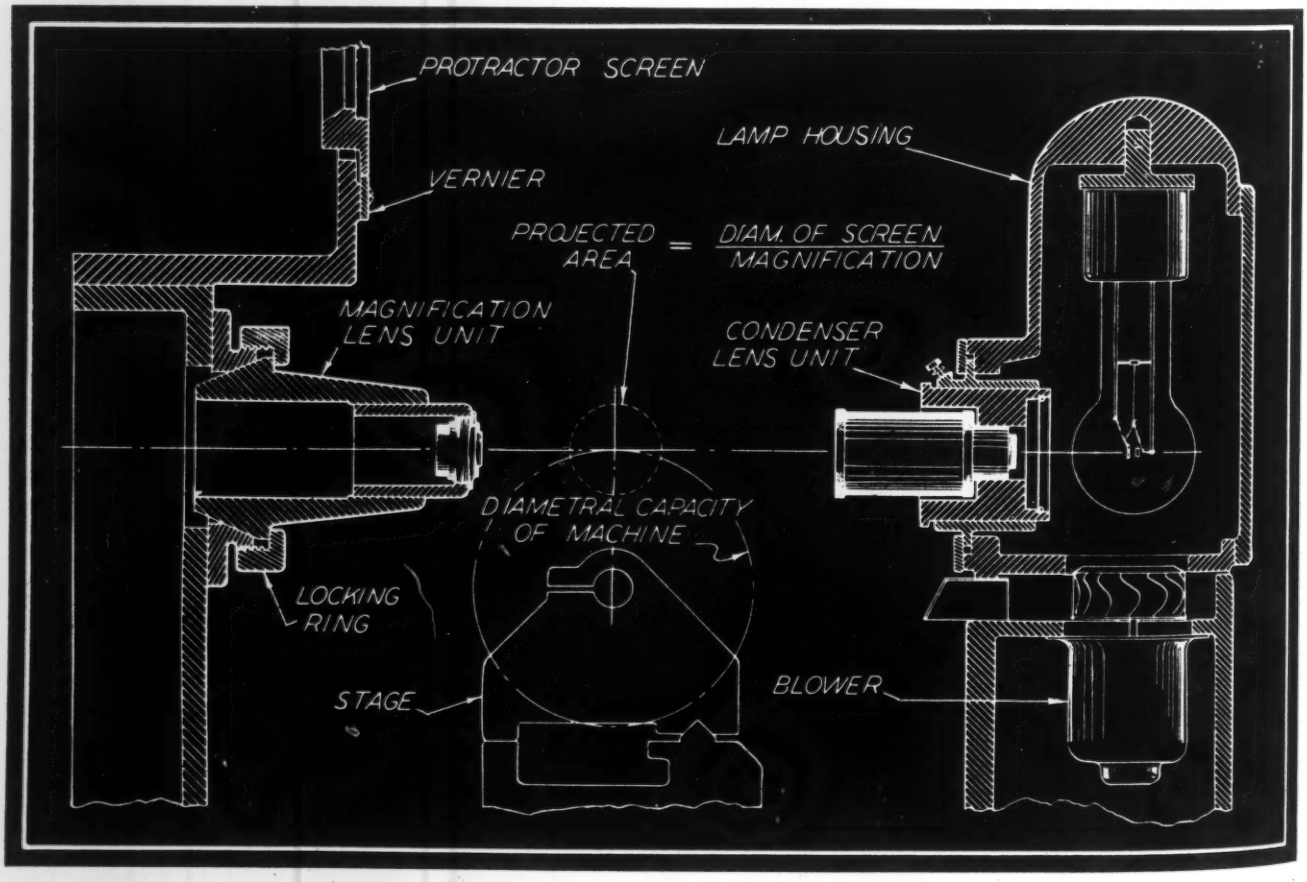
Of the generally recognized design requirements for a machine of this type, the most obvious are magnification accuracy and sufficient illumination. Conditions that have become evident during these critical times also called for simplicity of design for ease of operation and construction, using available materials. From past experience in the manufacture of smaller equipment it was recognized that difficulties in achieving required performance could be corrected only by making a larger and more accurate machine. Requests from users of such equipment confirmed the opinion that several seemingly unimportant features should be stressed in the construction. Foremost among these was rigidity. Other features which seemed to need further development included increased object-to-lens distance for greater optical and mechanical capacity, and increased illumination. No one seemed to be satisfied with shadow projection illumination (diascopic) which made necessary the shielding of the screen under most shop conditions. Surface illumination projection (episcopic) never was satisfactory unless a dark room was available for the location of the projector, especially above 25 magnification.

In designing for increased object-to-lens distance the most practical solution, considering lenses available from domestic sources, seemed to lie in increasing the projection distance (lens to screen). This condition expanded the choice of available lenses into the longer focus single-unit objectives used for photographic work requiring highly corrected lenses. Employment of single-unit lenses increased the illumination on the screen as well as increasing the object-to-lens distance. The use of highly corrected photographic objectives is preferable to combinations of poorly corrected short-focus dual elements which must be used with an extremely short projection distance. A photographic objective lens as used in high quality photographic engraving work is corrected for at least a circular area with a diameter equal to the focal length of the lens. In applying this type of objective to a projection system such as used in this machine, the percentage of the area used is a function of screen diameter and magnification.

Further advantages gained by using a long-focus, long-projection system included increased illumination due to the fact that long-focus lenses are relatively large in diameter, admitting more light and absorbing less light than two lenses of relatively small diameter.

Use of the larger range of long-focus objectives available solved the problem of illumination and increased object-to-lens distance for the medium and low range magnifications. In order to obtain longer equivalent focal

Fig. 2—Tungsten-arc microphotographic light bulb in blower-cooled housing provides illumination for part which is to be checked. Part supported on stage



lengths at extremely high magnifications, where a small portion on the circumference of a large diameter part must be projected, it is still necessary to resort to dual-lens units. In this case the illumination and definition have been improved by using highly corrected anastigmatic elements instead of microscopic lenses which usually are not corrected for a sufficiently large area and are small in diameter, restricting the illumination.

These improvements in design helped considerably in improving the surface illumination projection in that it admitted more light to the projection system. The problem was further solved by increasing tremendously the amount of illumination on the part, for reflection to the optical system. Surface illuminators that provide the light for reflection from the object are of high intensity ranging from 500 to 1000 watts, in a compact blower-cooled housing, similar to the shadow projection illuminator shown in *Fig.* 2. Units formerly available for this purpose were provided with 125 watts maximum.

Thick Mirrors Solve Flatness Problem

Mirrors presented another problem in design which had an important effect on the results. As the projection distance is increased the flatness of reflecting surfaces has a greater bearing on the distortion on the screen. At first relatively thin mirrors were used but it was found necessary to select them carefully for flatness. This was, of course, a costly and tedious job requiring "cut and try" assembly. The solution rested mainly in using extremely thick mirrors with the necessary inherent dimensional stability and worked to an extremely flat surface. Design of the mounts for these mirrors was of great importance, the main consideration being their effect on the mirror with regard to holding without distortion.

When used for precision measuring the optical comparator is a high-accuracy device. Consequently, extremely accurate measuring standards such as gage blocks are used. In the comparator, measurements are taken by moving the stage and using the magnified image outline of the part for determining how far the stage is moved from point to point of measurement. The measuring devices on this machine are built to match the accuracy of these measuring standards and to maintain repeatability of dimensions. Since gage blocks alone are not flexible enough for making many measurements, a .0001-inch micrometer is used in conjunction with them to give wide latitude in the reading of measurements. With this fixed micrometer, a fiducial (reference) mechanism is employed on the movable member of the stage for indicating zero pressure of the measuring system. The vertical measuring unit is shown in *Fig.* 3 in its relationship to the stage member and fixed column of the machine. The vertical bar is adjustable in the movable member so that the complete 8-inch range of the machine vertically can be utilized. In using this mechanism, the gage blocks are inserted between the micrometer spindle and the ground anvil of the measuring unit. Pressure upon the gage blocks by the micrometer spindle through movement of the stage actuates the dial indicator for zero reading only, the indicator not being used for measurement.

Horizontal measuring unit employs the identical system of measurement as the vertical and the illustration,

Fig. 3—Vertical measuring unit employs fixed micrometer working in conjunction with gage blocks

Fig. 4, shows the measuring unit complete with fiducial mechanism, the only difference being that the gage blocks are laid in the trough of the fixed stage member. The bar on the fiducial mechanism holding the anvil is adjustable for the entire 10-inch horizontal measuring range of the machine. In this case also the indicator is used only for reading zero pressure.

Design of the Portman machine lent itself well to the use of available materials. The main reason for this is that the movable parts do not receive the abuse and operating conditions of many other machines. Also, the parts are designed mainly for rigidity and therefore are usually oversize to the extreme. Wear is not a problem because the operating controls are manual and run at low speeds.

Dimensional Stability a Factor

Since many of the parts require intricate shapes and extreme rigidity, cast members had to be used. Meehanite castings were chosen for their close grain and their stability of dimension regarding aging. One of the main concerns in the design of this machine was permanent dimensional stability, because the original accuracy built into the machine must be retained.

Special alloy steels were not required except for a few parts that may get some wear or abuse through constant use. Brass is used for all graduated members such as protractor screen and vernier, and other measuring devices. This material was chosen mainly for its ease of engraving. Its appearance in the finished machined state also lends contrast to the appearance of the machine.

Because of the manual operation of movable controls and units, lubrication presented no problem—no lubrication retaining devices or sumps being necessary. Surfaces that must be lubricated were designed for accessibility and are entirely exposed. Lubriplate in the 130AA type and consistency was found to be entirely satisfactory

for the type of lubrication required. Its tenacity and adhesion qualities are well adapted to application for exposed gearing and shafting.

In attempting to obtain extreme accuracy with the comparator, too much emphasis cannot be placed on the importance of the comparison screen, that is, the drawing that is compared with the magnified shadow projected on the screen. Any discussion of the design of this type of equipment would therefore be incomplete without a discussion of projection screens and materials.

Ground glass is used for general-purpose measurement and comparison. As a rule, however, ground glass is not the best medium for producing a brilliant image at low magnification because it gives a scintillating or sparkling effect which is tiring to the eyes and tends to make the object appear as a bright star. However, ground glass is useful at high magnifications because it is luminous and tends to absorb less of the light than most translucent papers or other screen materials.

Special screens made by a draftsman are used when a quantity of parts is to be inspected or where any definite standards are to be maintained for special shapes. Within the last few years, several materials for making such charts have become available. Improvements in tracing papers have made them suitable as a medium upon which to draw special charts. However, no paper has the necessary stability for accurate "repeatable" measurements. All papers are hygroscopic and subject to considerable variations in linear dimensions. These variations can reach .02 or .04-inch on the full diameter of the screen. Paper, however, is suitable if it is used immediately and for only that one particular inspection. This limitation also holds for the celluloid type of sheeting heretofore commonly used.

Outstanding developments in permanent original screens include engineers glass, scribing engineers glass and Vinylite plastic rigid sheets.

Engineers glass is selected plate glass ⅛-inch thick with carefully ground edges, on which a high-grade drawing paper has been securely cemented. This combination of the two materials eliminates shrinking, stretching, buckling, and warping. The drawing paper—vellum—is extremely translucent, and can be used directly upon the screen of the projector.

Scribing engineers glass fills a great need where extreme accuracy is to be obtained in laying out the chart. It is selected plate glass covered with a uniform, thin, red coating. Scribing tools and machines are employed in scribing through this coating to the surface of the glass. The lines are then transparent on a red background. This type of chart, however, is not entirely suitable for direct use on the screen of the comparator. Its main purpose is to serve as the original for reproductions.

Vinylite plastic rigid sheeting is produced in a variety of thicknesses from .01 to .03-inch. Commercially it can be processed in almost any surface desired but for its use as a screen material it is usually .02 or .03-inch in thickness, transparent with a matte finish on one side and press polished on the other. These sheets are strong, stiff and permanent in size and form, having a linear coefficient of thermal expansion of .000069 per degree Cent. It is resistant to moisture and most chemicals, while aging has no effect on its composition or characteristics. Although considerably stiffer than most other thermoplastics having a given cross section, it will withstand considerable impact and continued flexing.

As *Fig.* 1 indicates, an attempt has been made to design the unit for pleasing, modern appearance, along strictly functional lines. Steel parts such as knobs, shafts, screws, handles, etc., are finished with the Ebonol process for black oxidizing. For the comparator this process is in many respects better than commercial plating because steel parts finished either naturally or plated with metals have a tendency to glare which, on equipment of this type, would be disconcerting to the operator.

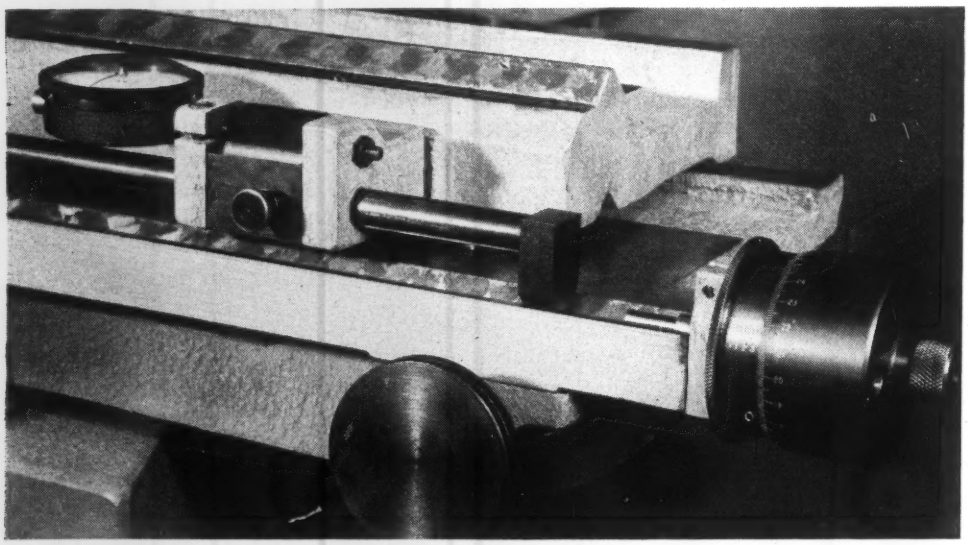
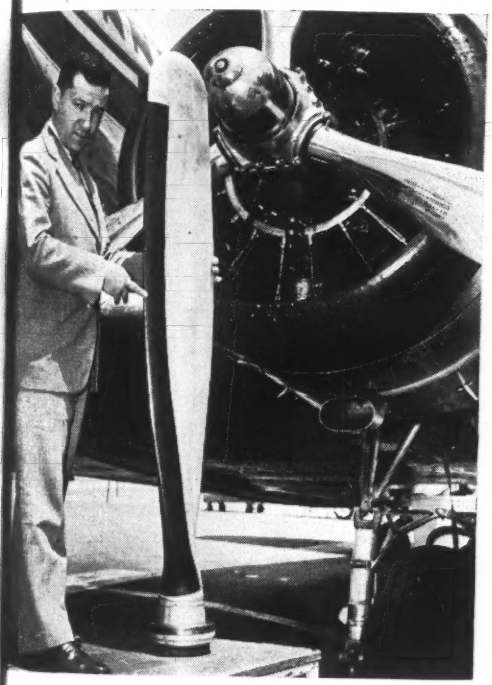


Fig. 4—Gage blocks used with the horizontal measuring unit are laid in the trough of the fixed stage member

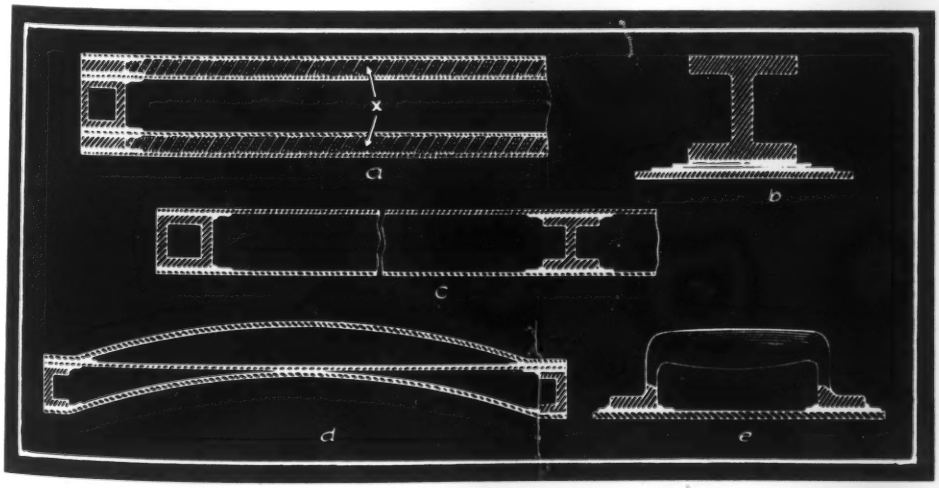
Cast members on the exterior are finished in a pleasing two-tone gray wrinkle finish which is extremely durable and is easily applied. The shell of the machine, comprising the light cover or body, is of formed sheet metal and is finished with the popular machine tool pebble effect. The interior of the machine including castings and all parts with the exception of the reflecting surfaces, must be finished in a dead flat black paint to remove the possibility of extraneous reflections reaching the screen. This is extremely important when exposures on photographic films are to be made.

Scanning the field for IDEAS



ANTI-ICING problems in aircraft such as on propellers may be solved through the use of electrically-heated conductive rubber. Shown at left, a strip of rubber which has been made a conductor of electricity by chemicals is attached to the edge of the blade. Passage of electricity warms the rubber and keeps the ice from forming, an advantage over methods of deicing which function after the ice has already formed. The device was developed by Dr. Marick of the United States Rubber Co. with the cooperation of the engineering staff at Wright Field. It is designed to remove the threat of loss of the airscrew efficiency and of the balance of propellers caused by ice collecting on the blades when sleet or icing conditions are met in flight.

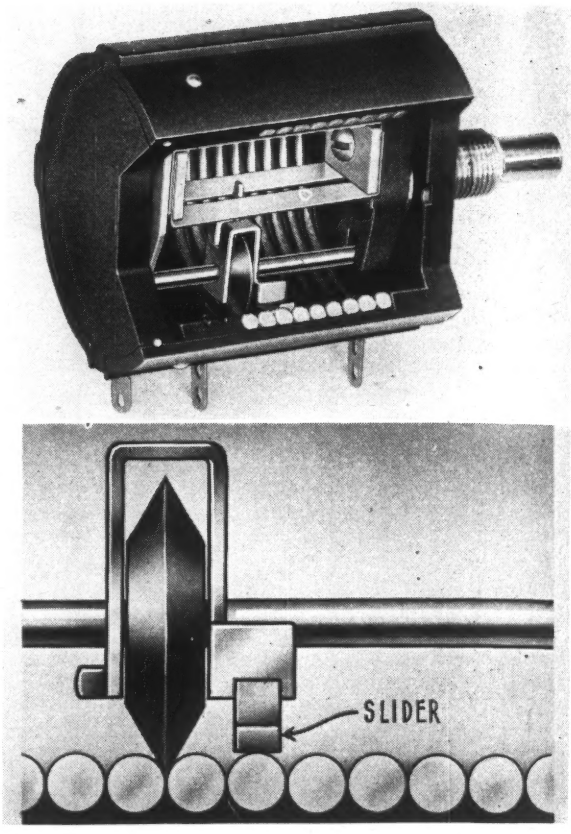
Bonds between related or entirely dissimilar materials eliminate welding or riveting in the structural assembly of thin metal sheets to heavy supporting members. Assemblies are mechanically strong, possess substantial heat resistance and have a definite tendency to absorb vibration. Developed originally by a Canadian chemist, the bond is a synthetic resin cement produced by the U. S. Stoneware Co.



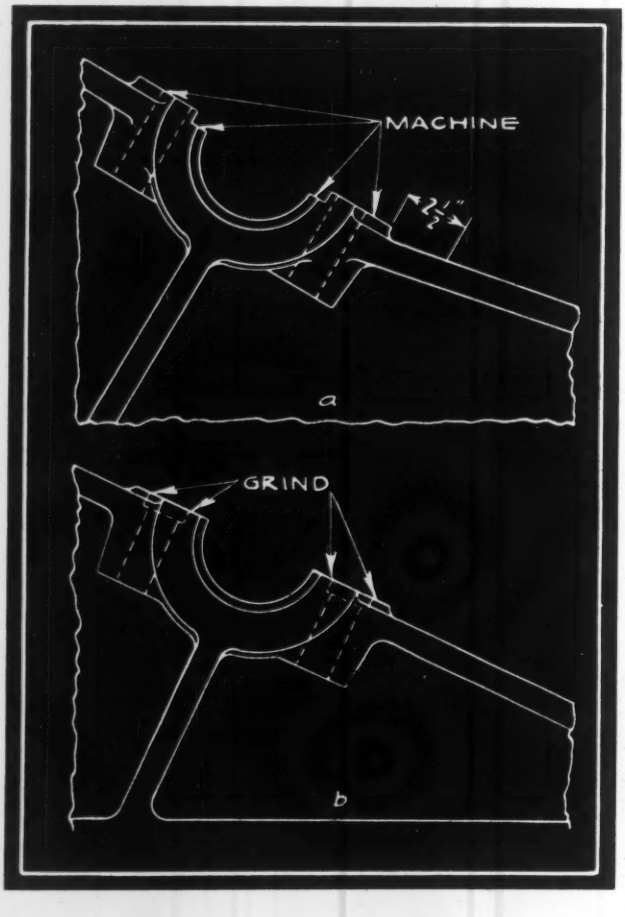
Rubber-to-metal bonds develop adhesion strengths up to 1200 pounds per square inch, in tension, depending upon the rubber compound and nature of metals bonded, without the necessity of brass plating. Adhesion is best when uncured rubber is applied although previously-vulcanized rubber as well as those containing large quantities of clay, reclaim, etc., are satisfactory. Some synthetics such as neoprene and Thiokol develop excellent bonds.

Metal-to-metal bonds

have run as high as 3000 pounds per square inch in shear. Assembly may be either metal to metal or with a layer of rubber between, the latter being particularly advantageous where vibration fatigue may be severe or where sound insulation is desirable. Shown at left are several designs of bonded joints. The insulated panel assembly at (a) is bonded with rubber and has the spaces marked "x" filled with insulation. Structural member (b) is an I-beam with rubber-to-metal adhesive, rubber sheet, and thin sheet of metal or foil. An airplane door is shown at (c) with rubber bonds indicated. The curved panel at (d) is suitable for an airplane bomb-rack door, while (e) indicates a method of mounting handles, hinges, etc., to relatively thin metal surfaces. Metal-bonded plywood develops strengths in the bonds superior to the strength of the wood and certain types of thermosetting plastics may be effectively bonded with metal.



Wide range of sensitivity in one compact unit having a single control knob is effected in the potentiometer illustrated at right. Utilizing an insulated copper wire core wound with resistance wire and formed in a helix, a guide wheel rides the grooves between the coils to advance the slider as the control knob is turned, thus effecting a constantly variable control. Designed by National Technical Laboratories to meet precise requirements for applications such as detection and range-finding instruments and other important military devices, this "Helipot" is indicative of the advances in design being made which combine better control, easier operation and elimination of parts.



Redesign of machine parts to permit the use of face grinding in place of other methods of machining has proved advantageous and economical in many instances. As an example, the American Engineering Co. redesigned a stoker crankshaft bearing bracket to utilize the face-grinding method, allowing the wheel to pass across the surface without fouling the bracket. Original and present designs are indicated at (a) and (b) in the drawings at left.

The bearing cap surfaces illustrated are especially adapted to face grinding. Cutting tools travel at metal cutting speed whether they cut metal or pass over a recess except in special machines where rapid traverse is incorporated. With a face grinder, grinding time is more proportionate to the amount of metal removed. In the case under discussion, a comparatively simple change in design made it possible to effect economies especially important in these days of stiff production schedules and operators with less than usual skill.

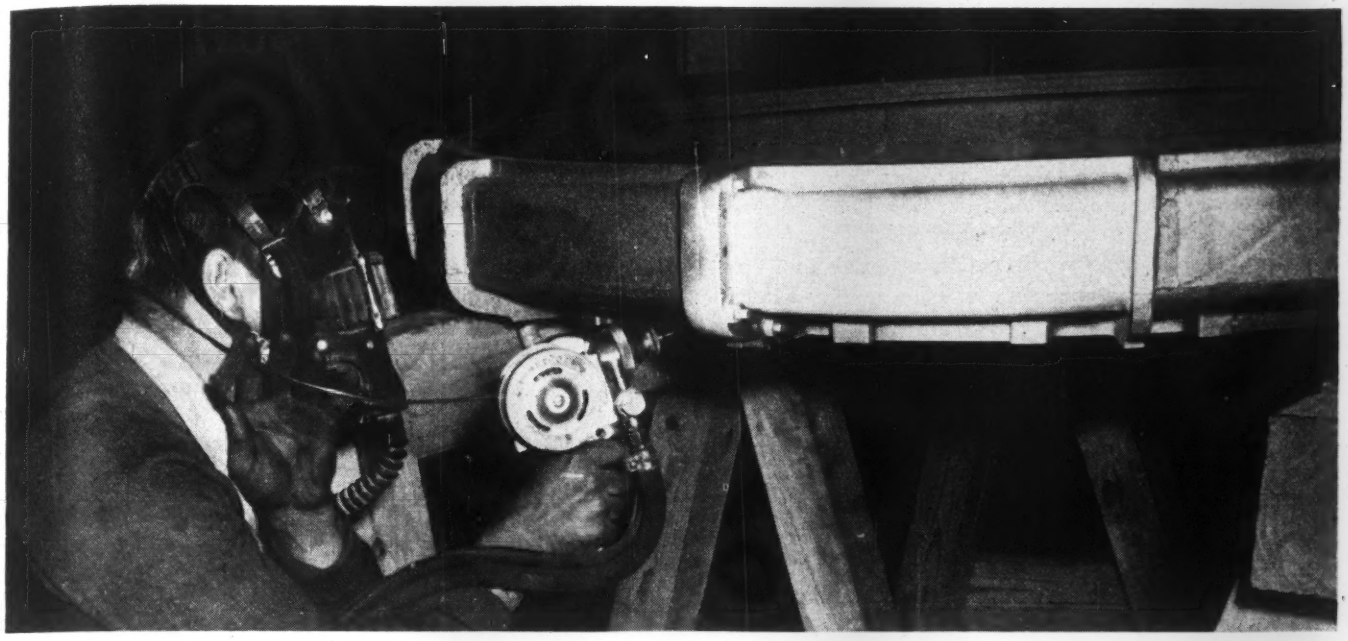


Fig. 1—Cast-iron gear shroud of antiaircraft gun mount being sprayed with zinc to improve corrosion resistance

Selecting Metallic Coatings for Machine Parts

By Richard K. Lotz

PROTECTION of machine parts from the corrosive action of chemicals, moisture and a variety of atmospheres has long commanded the attention of machine designers. Today, with widespread drastic curtailment of strategic materials, many of which—such as stainless steel—have in themselves corrosion-resistant qualities, designers are finding themselves confronted with substitution problems which give promise of being difficult to handle for some time. In addition to the shortage of materials from which the actual parts are made, there exist also on the critical list those metals which customarily are used for parts coatings.

Because the availability picture is changing almost daily, it is impossible to provide an authoritative listing of the strategic materials along with recommended substitutions. However, a thorough working knowledge concerning all the commercially available types of metallic coatings should go far to aid the designer in successfully overcoming the difficulties which are directly due to materials shortages.

There is no one coating which will best meet the specifications of all types of machine parts any more than there is one lubricant which will serve best for all lubricating purposes. Let us consider the control levers and knobs such as are found on various instruments, typewriters, cameras, etc. Here the coating must not only resist moisture, the actions of a diversity of atmospheres and the acid action of hand perspiration but, in addition, must resist abrasive wear encountered in the normal handling of the mechanism. Over and above these, the coating must also serve to enhance the appearance of the

FORCED by materials shortages to specify metals which do not inherently possess adequate wear, abrasion or corrosion resistance, designers are becoming increasingly cognizant of the protective properties offered by metallic coatings. Competent coating selection requires a thorough knowledge of the characteristics of such finishes. Properties of the most prominent metallic coatings are presented in this article

mechanism. A highly polished chromium plating is generally used to meet these requirements.

However, there are many other parts applications where chromium would not be indicated. For example, to chromium plate a link or lever which is not readily visible from the exterior of the mechanism would be sheer extravagance. Nevertheless, the fact that the part cannot be seen and is not subject to abrasion does not necessarily indicate it needs no protection from corrosion. For such parts, other metallic coatings are suitable.

To provide information on coating materials and application processes which have never been readily available on a commercial basis would serve no practical purpose. This article therefore will be confined to the coatings and coating methods which most generally are used specifically for the surface treatment of machine parts.

Variety of Processes Employed

Electroplating, hot dipping, spraying and cementation are the methods in most prevalent use. While other processes such as cathode sputtering and application by the condensation of metal vapor are available, their use is extremely limited, especially for machine parts.

Of the host of materials available as coatings, those finding most widespread application are brass, cadmium, chromium, copper, lead, nickel, tin and zinc. Information on indium has been included because its potentialities as a coating adjunct warrant the attention of the design profession.

ELECTROPLATING: More extensively used than other methods for metallic coating of machine parts, electrodeposition is based on principles which generally are well recognized. The part which is to receive the metallic coating is placed in an electrolytic bath where, during the plating operation, it functions as the cathode. The metal to be deposited as an electroplate is customarily placed in the bath as the anode and deposition is accomplished by forcing an electric current through the bath under the impetus of electromotive force supplied by storage batteries, direct-current generator or a rectified alternating-current source.

Myriad metal ions are deposited on the cathode and form the metallic coating. These ions emanate from the metallic salts in the bath as well as from the anode which slowly dissolves under the applied electric potential. When insoluble anodes are utilized, all the metal ions to produce the coating must come from the electrolytic (plating) bath and it becomes necessary to replenish the bath periodically by additions of metal as oxide or hydroxide. Electroplate thicknesses are proportional to the period of deposition.

HOT DIPPING: As the name implies, this process involves dipping the part to be coated into a molten bath of the coating metal. Best results are obtained with hot dipping when the coating and base metals will alloy with each other. While this alloying action is not absolutely necessary, without it the coating has a tendency to draw away from the base metal during solidification.

Metals such as tin and zinc have a natural alloying affinity with iron and steel, while lead offers no such affinity at all. However, lead coatings will adhere satisfactorily to iron and steel if a coating of tin is first applied to the base to act as a "bond".

Hot dipping has proved most satisfactory for coating with metals which have low melting points, such as zinc, tin and some lead alloys. Aluminum coatings have been applied by hot dipping but not to any great extent. Hot-dip coating with metals having high melting points has not proved commercially practicable because of the difficulty experienced in handling the baths and the possibility of harming the base metal by the intense heat.

Metallic Coating Characteristics

Coating Material	Process of Application*	Thickness (inches)	Corrosion Resistance	Abrasion Resistance	Decorative Value	Coating Function	General remarks
Brass	E	.00002-.0001	poor	poor	.....	Improve adhesion of rubber to steel	
Brass	E	.0001-.0003	poor	fair	good	Decoration	Sometimes coated with clear lacquer
Cadmium	E	.00015-.0003	good	poor	fair	Resist corrosion indoors	
Cadmium	E	.0003-.0005	good	poor	fair	Resist corrosion outdoors	
Chromium	E	.00005-.0001	excellent	fair	excellent	Decoration and resist corrosion	Usually over copper-nickel base coating
Chromium	E	.0005-.003	excellent	excellent	excellent	Resist wear, abrasion	On bare base metal
Chromium (porous type)	E	.003-.020	.....	excellent	.....	Resist wear, abrasion	Lubricated
Copper	E-M.S.	.0003-.0006	poor	poor	poor	Localize hardening of steel	Also base coat for nickel, nickel-chromium
Lead	E-H.D.	.001-.004	good	poor	poor	Corrosion resistance	Subject to rust spotting
Nickel	E	.0005-.0015	good	good	good	Base for chromium	
Nickel	E	.001-.002	good	good	excellent	Decoration	Should be substantially pore-free
Nickel	E-M.S.	.001-.002	good	good	good	Corrosion resistance	
Tin	E-H.D.	.0003-.002	good	poor	good	Corrosion resistance	Tarnish resistant
Bright Zinc	E-H.D. C-M.S.	.0003-.002	good	poor	good	Corrosion resistance	Will darken with time

* E—electroplating; M.S.—metal spraying; H.D.—hot-dipping; C—cementation.

Fig. 2—Bore of aircraft engine cylinder is plated with porous chromium to improve wear properties and retain lubricating-oil

Coatings applied by the hot-dip process are usually thicker than those deposited by other methods.

METAL SPRAYING: Because metal spraying is most generally thought of as a process by which the building up of worn machine parts is accomplished, the designer is apt to overlook its possibilities for application of corrosion-resistant coatings especially as applied to comparatively small parts.

Limitations of the process are few. Any metal which can be obtained in wire form and is fusible in the flame of acetylene, hydrogen, propane or natural gas, can be sprayed. Then too, such coatings are not only applicable to metals, but have been applied successfully to such materials as glass, wood and cloth. Application is effected by means of a "pistol", at the nozzle of which the automatically fed wire is melted and projected in the form of a spray by compressed air.

Surface preparation of the base metal is of extreme importance, as adherence of the sprayed coating is purely mechanical. For most applications, sandblasting provides a sufficiently rough surface to insure proper anchorage. Where a coarser surface is required, blasting with angular steel grit and cracked shot is utilized. In any case, the surface must be densely covered with irregular recesses, pockets and indentations which serve to "key" the coating securely to the base metal.

CEMENTATION: Here as in the case of hot dipping, is found the phenomenon of alloying between metals effected at temperatures below their melting points. The coating produced is not a layer of the pure coating metal, but rather an alloy of it and the base metal. This alloy layer is usually harder than the pure metal.

Since the process requires the base metal parts to be tumbled in a barrel which contains a quantity of the cementing metal powder, it will be apparent that cementation is applied most widely to small parts. The sealed barrel with its load of parts and metal powder is heated for several hours, during which time the tumbling parts are thoroughly covered by the alloy coating.

In common with all other metal-coating methods, the base metal surface must be carefully cleaned to insure thorough coverage and adherence.

Once the designer knows what each coating has to offer, he can base his selection of finish on such factors as:

Operating locale of part: Will it be used at or near a sea coast area, on shipboard, indoors, outdoors, in contaminated or industrial atmosphere or in the presence of corroding fumes?

Wear: Is the part to be subjected to friction? If so, of what magnitude? Will it be lubricated? What material will it be in contact with?

Abrasion: Will it be exposed to the scoring action of gritty particles in handling or operation?

Decoration: How important is appearance of the part? Is part concealed or exposed? Is the decorative-enhancement cost offset by added sales appeal?

As already has been indicated, no one coating is the ideal panacea for all corrosion, wear, abrasion and decoration problems. Therefore, to select coating competently, a general knowledge of the characteristic merits and limitations peculiar to each is imperative.

Characteristics of Coatings

BRASS: Electroplating of brass is accomplished by the simultaneous deposition of copper and zinc, the coating thus effected being a true alloy and not merely a crystalline mechanical mixture.

One of the principal uses for brass plating on steel is to enhance the rubber-adhesion properties of the base metal.* Thus, for rubber rollers, where the rubber must be bonded to a steel shaft or core, brass plating is utilized. the minimum thickness of coating being .00002 inch.

Brass plating is often used on steel and iron parts such as hinges, locks, etc. In these cases it is utilized mainly for its decorative value, its corrosion-resistant properties being none too effective, although the application of clear

*E. T. Candee, Technical and Development Supervisor, The American Brass Company.

lacquer over the brass will help in some measure to retard corrosion.

CADMIUM: While cadmium coatings can be and are applied by a variety of processes, the predominant method employed is electroplating.

Of the many factors which contribute to the corrosion-resistant properties of cadmium and the other metallic coatings, thickness of coating exerts the greatest influence. In exposure tests made under the joint auspices of the American Electroplaters' Society, the National Bureau of Standards and the American Society for Testing Materials, it has been found that the protective values of cadmium and zinc coatings on steel are, for all practical purposes, proportional to the coating thicknesses. Cadmium coatings .0002-inch thick will suffice for most parts which are subject to typical indoor exposure, while a .0004-inch thick coating is generally indicated for the more severe typical outdoor exposure.

Plating Cost Relatively Low

Although the cost of the metal itself is high, cadmium plating is inexpensive because, as mentioned, the coatings are extremely thin. Another important consideration from the cost standpoint is the fact that cadmium's electroplating baths are easily controlled and have good throwing power.

Because cadmium is anodic to iron and steel it affords "sacrificial" protection to these base metals. This means that, even if part of the base metal is exposed, the cadmium will corrode away before the base metal begins to rust. Parts coated with cadmium will prove highly resistant to the action of the weaker alkalis.

Properly applied cadmium plate is satiny silver-white in appearance and although its sheen is not as brilliant as chromium or nickel it lasts a long time, tarnishing at about the same rate as nickel. Its surface is highly receptive to solder and does not readily oxidize, so it is not surprising to find such items as electrical contacts, terminal lugs, radio chassis, etc., being advantageously fabricated of cadmium-plated steel.

Coatings of cadmium are not as likely to be porous as are the other metallic platings and, because they are ductile, extremely thin and require only short plating periods at a relatively low temperature, they are used safely on springs and lightweight hardened-steel parts without undue danger of embrittlement.

Among the many iron, steel, brass and copper parts customarily coated with cadmium are levers, links, pawls, disks, flat and coil springs, screws, studs, spacers, shafts, gears, nuts, etc. In specifying, however, it should be remembered that cadmium is extremely poisonous and should never be used for food or beverage containers.

CHROMIUM: Perhaps no other finish serves in such a variety of applications as does electroplated chromium. It has excellent corrosion, wear and abrasion-resistant properties and its decorative qualities have long been demonstrated through its extensive use on the trimwork of automobiles, pleasure boats, all types of office and household equipment, etc.

In common with other metallic coatings, the thickness of chromium plate is an important factor in determining its effectiveness for various types of application. Where it is used primarily for decoration, only a thin "flash" coating is required, (.00005 to .0001-inch thick[1]) generally over a base of nickel, copper, or both.

Heavier coatings customarily are applied, directly to the base metal, to resist wear and abrasion on such machine parts as cams, feed screws, spindles, lathe centers, crossheads, guides, pump shafts, etc. In the majority of such applications a heavy plating is first applied, after which the part is finished smooth to size by grinding or lapping, the final resulting plate thickness ranging from .0005 to .003-inch[2].

To offer maximum resistance to corrosion, chromium plate on steel should be applied .00005 to .0001-inch thick[1] over a base plating of nickel on copper. Necessity of the base plating is due to the tendency of chromium to show some porosity and, as chromium is cathodic to steel, rust spots develop in the presence of moisture when the chromium is plated directly to steel. However, where chromium is plated to nonferrous base metals, the copper undercoat is dispensed with because such bases are inherently more corrosion resistant than steel.

Properly applied chromium plate will resist the corrosive action of salt solutions and water remarkably well. Its resistance to strongly oxidizing acid solutions is good, but it will not protect against acids which are not strongly oxidizing and most acids fall into this nonoxidizing classification.

A noteworthy property of chromium is its extreme hardness. Yielding a value of up to 1200 brinell, its scratch hardness is nine compared to ten for diamond.

Application of Porous Chromium

A special application of electroplated chromium is found in the surface treatment of internal combustion engine cylinder walls, as shown in *Fig.* 2. Here the chromium plate is utilized to resist wear, corrosion and abrasion as well as to facilitate lubrication by virtue of the structural character of its deposition.

The continuous surface of the customary chromium finish does not possess good oil "wetting" properties. However, by employing an electroplating technique which produces a microscopically pitted or pored chromium surface, the nonwetting property is overcome and the porous finish takes on the aspect of an effective lubricating-oil reservoir.

Thicknesses of porous chromium finishes range from .003 to .02-inch depending on service requirements. The density of such coatings is about thirty percent less than dense chromium. Other applications for the porous-type chromium plate are crankshaft bearings, crosshead pins, valve guides, machine tool ways, etc.

COPPER: For coating iron and steel parts with copper, the two processes most generally employed are electroplating and metal spraying. Its deposition by either of these methods produces a coating which is dependent for adhesion on physical anchorage rather than diffusion with the base metal.

Commercial carburizing plants employ copper plating

(*Continued on Page* 282)

[1]*Corrosion Resistance of Metals and Alloys*—McKay and Worthington, Reinhold Publishing Corp.

[2]"Chromium Plate in Engineering Applications"—T. G. Coyle, preprint of A.S.T.M. paper, 1943.

The Shape of Things To Come

Part III—Complex Rectangles

By R. S. Elberty

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DESIGN of machines embodies three dimensions, and styling must consider the combined effect of all views. While the designer draws the projections to show one surface only, the completed machine is viewed as a whole. Many related combinations and divisions of the basic root rectangles will give unity to a design, but the compound rectangles will provide an added field of basic knowledge for the designer. In fact, any study of root rectangles and their division naturally leads to the development of compound rectangles. The Greeks preferred the use of compound rectangles based on the "golden rectangle" and its relationship to the root 5, the root 4, and the square.

The golden rectangle can be derived synthetically by mathematics, but the ratio may be found in some pro-

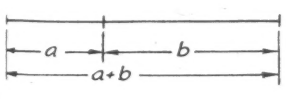


Fig. 22 — Proportions for golden rectangle where the ratio of lengths is mean and extreme

portions of natural growth and the mathematics of harmonic vibrations. The geometrical problem is to divide a line into mean and extreme ratio or the "golden proportion". However, the close relationship between the golden rectangle (called GR hereafter) and the root 5 is best shown by an algebraic solution of the problem. Referring to *Fig.* 22, the golden proportion may be written

$$a:b=b:a+b$$

Letting $b=1$,

$$a:1=1:a+1\ ;\ a^2+a=1$$

$$a^2+a+\frac{1}{4}=\frac{5}{4}\ ;\ a+\frac{1}{2}=\frac{\sqrt{5}}{2};\quad a=\frac{\sqrt{5}-1}{2}=.618=\frac{1}{a+1}$$

$$a+1=\frac{\sqrt{5}+1}{2}=1.618=\frac{1}{a};\quad (a+1)^2=2.618=a+2$$

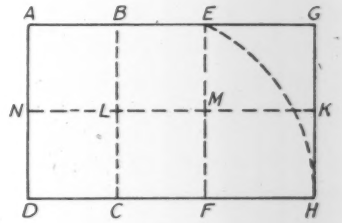


Fig. 23—Construction of golden rectangle

There is a reciprocal relationship expressed here, the supplement of a golden rectangle being the reciprocal of a golden rectangle, expressed GR—1=1/GR and proved as follows

$$\frac{2}{\sqrt{5}+1}=\frac{\sqrt{5}-1}{2}\ ;\ \frac{4}{2\sqrt{5}+1}=\frac{(\sqrt{5}-1)(\sqrt{5}+1)}{2\sqrt{5}+1}$$

$$4=(\sqrt{5}-1)(\sqrt{5}+1)=5-1=4$$

The ratio then uses the values $(\sqrt{5}\pm1)/2$ or, in decimals, the numbers 1.618 and .618.

Another method of approach is to start with the summation series of numbers: 1, 2, 3, 5, 8, 13, 21, 34—1597, 2584, 4181, etc., where each number is the sum of the two preceding numbers. These numbers follow the golden proportion as closely as can be obtained with whole numbers. This might be expressed as $8:13\approx13:21$ or $.61538\approx.61985$, the error being less than one per cent. Higher numbers in the series may be taken and the expression becomes more nearly true. For example, $34:55\approx55:89$ or $.61818\approx.61797$, with negligible error.

This is the natural law governing the number of rows

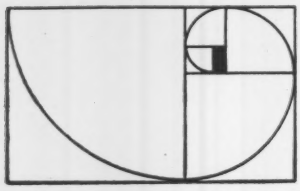


Fig. 24—Progressive subtraction of squares from a golden rectangle gives construction points for spiral, indicating reason for calling it the "rectangle of the whirling squares"

of seeds on sunflowers and pine cones. A musical relationship is shown in the intervals of the major chord, these being 3, 5 and 8. If these intervals are multiplied by 2, 6, 10 and 16 are obtained, which represents the minor chord. In half tones, the major chord is 5, 8 and 13, the minor 10, 16 and 26.

Geometrically, the GR may be constructed as shown in *Fig.* 23. *AD, AE,* etc.=1; *CF*=½; and

$$CE=\sqrt{\frac{4}{4}+\frac{1}{4}}=\frac{\sqrt{5}}{2}=CH$$

$$DH=\frac{1}{2}+\frac{\sqrt{5}}{2}=\frac{\sqrt{5}+1}{2}$$

In *Fig.* 23, *ABCD, BEFC, AEMN,* and *NMFD* are root ¼ rectangles; *BGKL* and *LKHC* are similar to root 5, *AGHD* is a GR; *EGHF* is a reciprocal and also a supplement GR.

If a square is subtracted from the GR a similar rectangle is left, and a square may be subtracted from each remaining rectangle to leave other similar rectangles. *Fig.* 24 shows this construction and shows why the GR is sometimes called the "rectangle of the whirling squares". The spiral is the Archimedes or logarithmic spiral; an approximate construction using a compass is evident from the figure.

Fig. 25 shows a root 5 divided into a square and two 1/GR. *Fig.* 26 shows two root ¼ and one 1/GR arranged to form a GR. *Fig.* 27 shows how the GR may be composed of two squares and two rectangles similar to the root 5. These figures indicate the wealth of combinations possible with the GR. Whereas the basic root rectangles can be combined dynamically with themselves or their reciprocals, the GR can be combined with the square, the root 4 and the root 5. The supplement GR equals the reciprocal, therefore complements and supplements take on added meaning when considered in combination with the GR.

With the exception of the root 4, the complements of basic root rectangles complete the square, but they do not have much in common with the rectangle. The root 4 complement equals the root 4 and provides an arithmetic form of symmetry. To obtain dynamic proportions a rectangle may be assumed such that the complement will be a rectangle similar to the supplement. In *Fig.* 28, the complement *FDGI* is similar to *BCDE*:

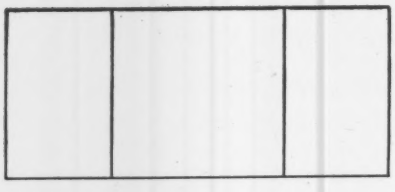


Fig. 25 — Root 5 rectangle divided into square and two reciprocal golden rectangles

$$1:(x-1)=(x-1):x$$

$$x^2-2x+1=x;\ x^2-3x+1=0$$

$$x^2-3x+\frac{9}{4}=\frac{5}{4};\ x-\frac{3}{2}=\frac{\sqrt{5}}{2}$$

$$x=\frac{3+\sqrt{5}}{2}=1+\frac{\sqrt{5}+1}{2}=1+GR$$

The rectangle *ACDF* is therefore composed of the GR, *BCDE,* and the square *ABEF. FDGI* is similar to the GR and *FEHI* is a GR. *ACDF* is also similar to the complement GR and it can therefore be called the "golden complement" and abbreviated as GC. *Fig.* 28 shows that the supplement is also the supplement of the complement since the supplements of *ACDF* (*BCDE*) and *FDGI* (*FEHI*) are equal. The diagonals *BD* and *FC* are perpendicular to the diagonal *IE.*

In order to design a suitable cabinet to house a record changer, two loud speakers, amplifier and record albums, the functional part of the design was first considered.

Complex Rectangle Proportions

Rectangle	Basic Figure	Complement	Reciprocal	Comp. of Reciprocal
GR*	1.618	.618	.618	.382
GC†	2.618	1.618	.382	.618
Root 3/2	1.225	.225	.826	.174

*Golden rectangle.
†Golden complement rectangle.

The 10-inch record album is 10½ inches high, an 8-inch speaker requires at least 10 inches to mount, and the height of the automatic record changer requires 10½ inches. Therefore a height of 11 inches was selected.

The record changer required a square 14 inches on a side for mounting as did the 12-inch loudspeaker. A 12-inch record album is 12½ inches high by 13½ inches deep.

Fig. 28 was then selected as a basis for the design, the dimensions being 11 × 1.618 or 18 inches to the nearest

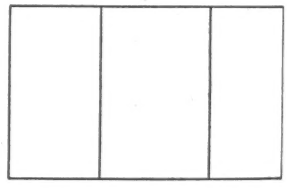


Fig. 26 — Golden rectangle formed from two root 1/4 and one reciprocal golden rectangle

inch. A summation series for this design would be 3, 4, 7, 11, 18, 29, etc. Fig. 29 shows the final result, the upper rectangular compartment housing the player mechanism, the lower rectangular compartment housing albums. The square compartments house the two loudspeakers and amplifier equipment. Two door handles were located at the intersection of the three diagonals as indicated in the drawing, *Fig.* 29. The final design is no more than a division of a square into GR and GC.

So far the GR and GC have been considered as special rectangles with no relationship to the basic root rectangles. These rectangles may be expressed as root rectangles, the GR as a root 2.618, the GC as a root 6.854. Perhaps this may be carried further, a rectangle having the short side equal to $\sqrt{2}$ and the long side equal to 2 being similar to the root 2, since $2:\sqrt{2}=\sqrt{2}:1$ *Fig.* 30 has the short side equal to $\sqrt{2}$, the long side equal to the $\sqrt{3}$. If the short side is considered as unity ($\sqrt{2}/\sqrt{2}$) then

the rectangle may be considered a root 3/2 or a root 1.5. There is design merit in these mixed root rectangles, but the study of dynamic symmetry has not previously considered them. Thus *Fig.* 30 is valuable when considered as a basis for a rectangle to be divided into six equal parts similar to the whole and, except for the root 6, this is the only rectangle that can be so divided. In like manner a root 5/2 can be divided into ten parts and a root 5/3 into fifteen parts. Or, knowing the number of parts the rectangle can be constructed, several solutions being possible if the number of parts can be factored in several ways. Thus twelve equal and similar parts will go into root 12, root 6/2 (root 3) and root 4/3 rectangles. A synthetic rectangle can therefore be constructed to meet

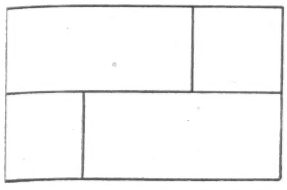


Fig. 27—Method of composing a golden rectangle from two squares and two root 5 rectangles

any condition for arithmetic division into dynamic parts. A general solution might be expressed by the formula: "A root a/b rectangle may be divided into ab similar rectangles." The proof can be stated in the formula $a:b = 1/b:1/a$.

Mixed root rectangles are a useful addition to the other dynamic rectangles. The machine designer will find them particularly valuable since the standardization of parts tends to favor arithmetic combinations. As we have seen, any arithmetic combination may be dynamically ar-

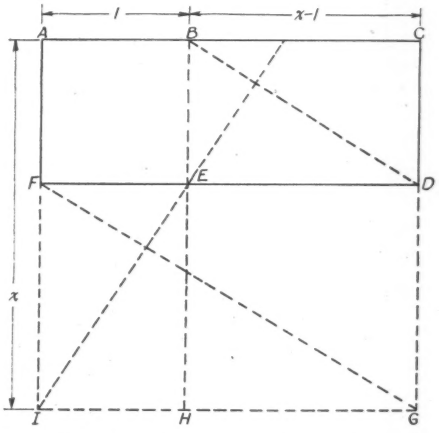


Fig. 28—Combination of golden rectangles and squares to form a square

ranged through the use of the mixed root rectangles, or basic reciprocal combinations.

Many special machines are made from assemblies of standard parts. In the machine tool industry for example, the power pack idea enabled a large degree of flexibility in the construction of special tools for the automotive industry. Standardization of parts may be expanded to include the standardization of machine subassemblies. But how can the designer be sure that *any* combination of the standard assemblies will be correctly styled?

A hint of the solution is found in nature. It has been noted that the summation series governs many forms of

*Machine Design, Aug., Page 117.

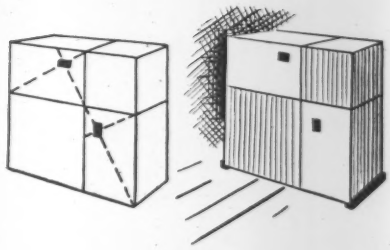


Fig. 29 — Record player design utilizing Fig. 28

animal and vegetable growth. Suppose a summation series were selected for all machine design, then all machines of the future would go well together. Such a series does not permit fractional numbers, the designer need not be bothered with complex ratios and unity of design is achieved since all designs are related to each other. In the series 1, 2, 3, 5, 8, etc., the ratios 1.618 and .618 apply to successive numbers, the GC ratio is obtained from alternate numbers (3, 8, 21, 54, etc.) and the root 5 ratio is obtained when any number is compared with the sum of the two adjacent numbers (5:11, 3:7, 8:18 etc.). All of these ratios are dynamic in their nature.

It is therefore possible to select a summation series and apply it as a standard guide for dimensioning of machines so that any grouping of parts or completed machines will show related values and the combination will be pleasing. The unit of measure can be selected small enough so that accuracy can be obtained in the dynamic relationships. For electrical appliances, office machinery, or other small devices, the unit could be ¼-inch. Machine tools might use 1 inch as a unit, while extremely large structures might use 1 foot as the smallest unit of measurement.

Complex rectangles add more numerical ratios to those tabulated in Part 1* for the basic root rectangles. For the benefit of those machine designers who prefer to use these numerical means, the additional ratios are shown in the accompanying tabulation.

These brief notes can only indicate the possibilities of dynamic symmetry as applied to design of the machine. Once this geometry of design is understood, limitless opportunities for satisfactory and accurate styling will be within the grasp of the engineers who will design our industrialized world to follow. The designer can fortify his artistic talents by means of his scientific knowledge and mathematical ability. Many of the world's great artists have been great engineers. Ours is the age of engineering and engineers should accept their position as leaders in directing the world of design to come. Our victories in battle are victories in engineering, too. Let us hope that these present triumphs will be projected into our designs for peacetime living.

This article concludes the series on the theory of dynamic symmetry. To emphasize its usefulness still further, a sequel will discuss additional pertinent applications.—Ed

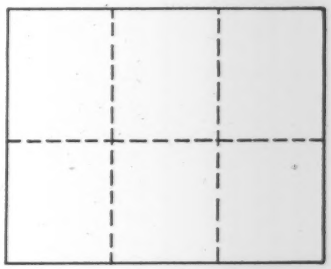


Fig. 30—Division of rectangle into equal parts similar to the whole

Utilizing Subzero Temperatures

By John W. Greve

SUBZERO temperatures as a useful tool have become more and more important. Accelerated by the unpredictable behavior of materials and operating parts of aircraft when flying at high altitudes, investigation of the behavior of parts at low temperatures is now being carried on intensively. Also, relatively recent researches disclosing beneficial effects of metallurgical treatments with subatmosphere temperatures for aging and improving the physicals of both ferrous and nonferrous metals have awakened engineers to the possibilities of incorporating subzero equipment in their heat-treating processes. In addition, the advantages of expansion fitting many assemblies such as hubs on shafts and the need for lower temperatures with more precise control for chemical processes such as production of chlorine for synthetic rubber have added to the demands for mechanical refrigeration as well as for further data on its uses.

Briefly, major industrial applications of refrigerating equipment may be grouped into the following classifications:

1. Stratosphere test chambers
2. Metallurgical treatment
3. Fabrication methods
4. Chemical processes, etc.

Chambers for laboratory-simulated stratospheres have been developed which are generally cylindrical enclosures of heavy-ribbed, fabricated-plate construction to withstand the reduced pressures employed. Because temperature changes are desired quickly to match the extreme climbing and diving conditions met by aircraft, heavy insulation is placed inside the enclosure instead of outside as is conventionally done. This reduces the load on the refrigerating equipment by the amount of the heat capacity of the heavy steel shell. The range of stratosphere units of this

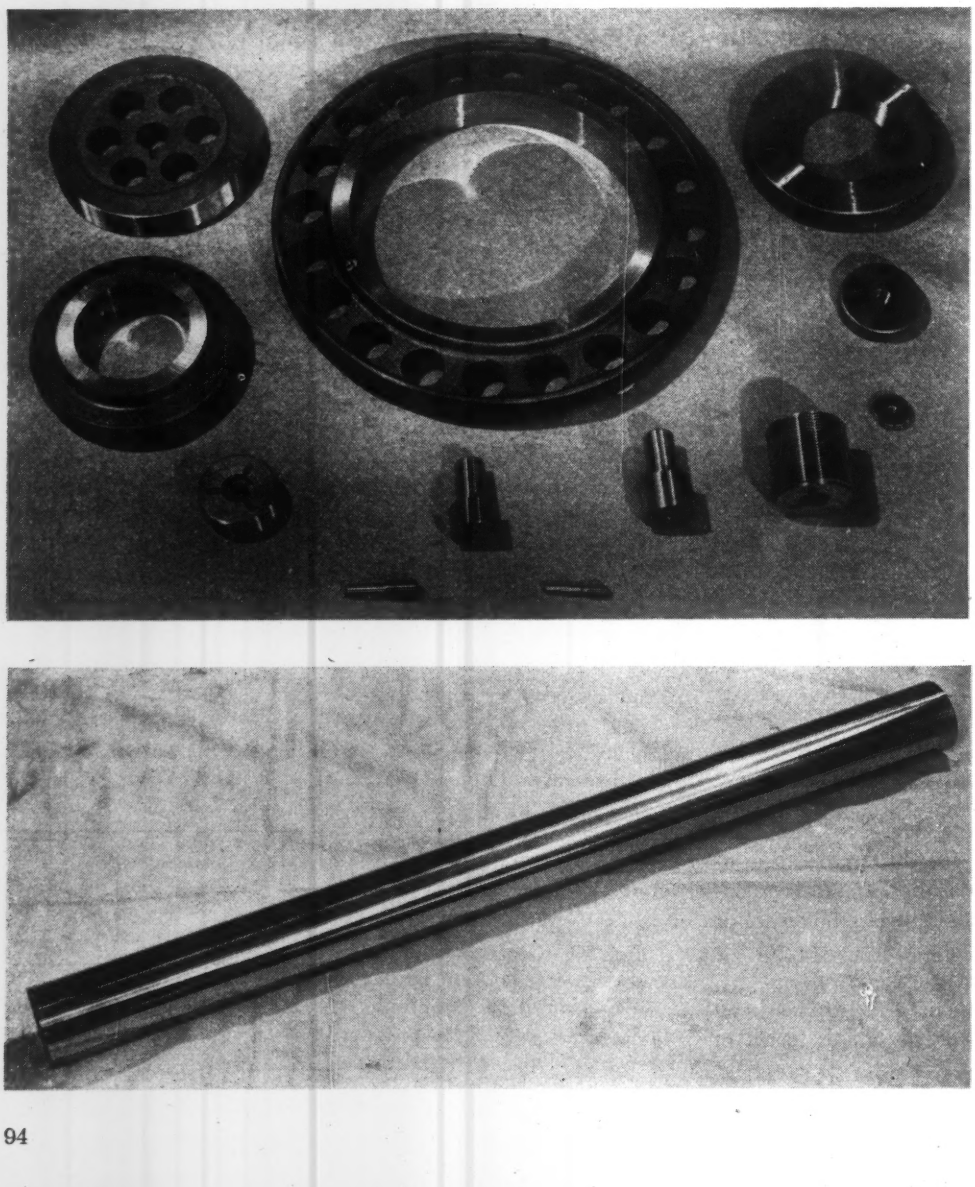


Fig. 1—Indicative of the stabilization obtainable with subzero treatment are these steel gages. Metal growth and warp are minimized when treated at —120 degrees

Fig. 2—Cylindrical way for machine tool of SAE 4615 is hardened to 62 rockwell C by treatment at —100 degrees following the quench. Bar is not distorted by treatment

type is from —50 to 200 degrees Fahr. According to the Advisory Committee on Aeronautics, the average operating conditions for different altitudes of flight are as shown in the accompanying table.

Temperatures and Pressures at Various Altitudes

Altitude (Ft.)	Temperature (F)	Pressure Absolute (in.)	Pressure Vacuum Gage (in.)
25,000	—30	11.1	18.82
30,000	—47	8.88	21.04
35,000	—65	7.04	22.89
40,000	—67	5.54	24.38

Generally at low-temperature service, metals show increased tensile, yield and fatigue strengths. Hardness also increases slightly. In fact, carbon steels behave as though they were heat treated instead of mild. Elongation and reduction in area decrease slightly. These factors in themselves, however, would not cause the designer concern nor indicate the selection of one material over another. Commercial ferritic steels and nonferrous alloys return unchanged to room temperatures.

Impact values cause the greatest concern in that physicals are affected at low temperatures. Sharp drops in Charpy values are characteristic of carbon steels although the "notch sensitivity" occurs at different values for different steels. Chemical analysis is no criterion for determining this sensitivity. Rather it seems most dependent upon the melting practice. Higher impacts are obtained from thoroughly deoxidized steels. Cold working as well as overheating reduces impact. Quenched and tempered steels display better properties than other heat treatments. Also, better properties are obtained from nickel steels than from low-carbon steels. Impact values of various steels are tabulated for different temperatures in A.S.M.E.—A.S.T.M. Project 13 "Impact Resistance and Tensile Properties of Metals at Subatmospheric Temperatures".

Contrasted with steel, most nonferrous materials either retain their impact value or show improvement at lower temperatures. Some copper alloys, in fact, have twice the normal impact value at —300 degrees Fahr. that they have at normal temperatures.

Insofar as metallurgical treatment is concerned, this is generally still in the development stages. Treatment of high-speed steels, gage blocks and aluminum alloys has progressed rapidly, however, and suggests that increased applications will follow, especially when the researches now in progress develop more data and better techniques. Metallurgists, nevertheless, do not look toward cold treatment as a panacea for their troubles. Present indications point toward advantages for specific applications as well as toward certain limitations.

Fig. 3—Plugs for airplane landing struts are cooled in refrigerating unit for expansion-fit assembly

When applied to high-carbon steels which have been properly quenched and not drawn back sufficiently to produce marked softening, the following beneficial results may be obtained: Increased hardness, improved strength at a particular hardness, and stability of dimension (i.e., a marked reduction in the degree of dimensional change which occurs with time in steels as conventionally hardened). Objectionable features of the treatment include: Larger dimensional changes from the machined body to the final condition than for conventional hardening, danger of cracking if not cooled with discretion, and need for repetitive cooling and heating to obtain desired properties.

Manufacturers of precision gage blocks have employed subatmospheric temperatures to their processes for at least twenty years. One procedure has been repetitive quenching from boiling water to iced brine. Because of the small differential in temperature a large number of cycles is required, perhaps 50 to 100. Now that practical means for obtaining lower temperatures are available, fewer cycles are required. Considerable experimental work will be necessary to establish the most effi-

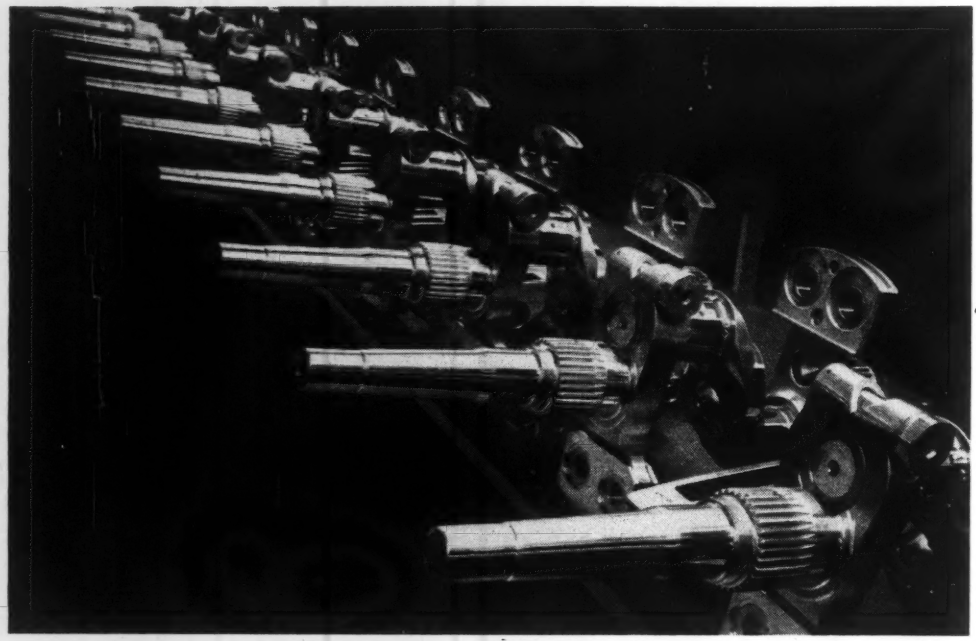


Fig. 4—Crankshafts for Wright radial aircraft engines have four parts assembled by expansion fitting including a plug, four dowel pins, counterweight bolt bushing and jets for directing flow of lubrication

cient combination of temperatures and number of cycles.

Marked improvements in hardness and ductility have been produced experimentally on high-speed steels by direct immersion in liquid nitrogen (—310 degrees Fahr.) before tempering and immediately following the quench. It is believed, however, that temperatures somewhat below —100 degrees which are available in commercial units can be utilized. Gordon and Cohen in their A.S.M.E. paper "The Transformation of Retained Austenite in High-Speed Steel at Subatmosphere Temperatures" discuss methods and time of treatment for 18-4-1 steel and the physical properties developed.

For finely machined precision parts, it has been the custom in the past to allow aging a number of years before machining. Because of the need for speed in war work, aging is now accelerated by low-temperature treatment, reducing the process to a matter of hours. For example, one manufacturer hardens and grinds gage blocks within .002-inch. Then the blocks are held at —50 degrees for ten hours. After reaching room temperature they are immersed in oil and gradually raised to 200 degrees, soaking for four hours. Again they are removed and allowed to reach room temperature after which they are subjected to a temperature of —50 degrees for ten hours. Practice, however, is not standard, each company having a process peculiarly individualistic.

In *Fig.* 1 is shown a group of cold-treated gages. Maximum hardness is obtained by eliminating elevated drawing temperature after quenching and securing stress relief by bringing the blocks from room temperature to —120 degrees Fahr. six times during the final finishing operations. This stabilization eliminates metal growth and warp, holding finished size under normal use.

The same manufacturer also stabilizes lapping blocks used in the production of these gage blocks by chilling. Previously the lapping blocks distorted from the release of strains on aging which made it necessary to resurface them every few hours. Now the plates retain their accuracy for two or three days.

Of particular interest to machine designers is the steel

Fig. 5 — Left — Inserting plug in crankarm of center section of a crankshaft. Plugs are stored at —35 degrees in cabinet shown

cylindrical way shown in *Fig.* 2. The manufacturer obtains an average of 60 to 62 rockwell-C hardness instead of 57 to 60 obtainable by regular treating. An SAE 4615 steel, way is treated at —120 degrees in a cooling machine manufactured by Deepfreeze Div., Motor Products Co. to obtain this additional hardness. Furthermore, the straightness of the bar is not distorted by cold treating which was the case in further normalizing operations that were used previously.

Important in aircraft is the refrigeration of aluminum alloys prior to forming which otherwise would age harden at room temperatures within a few hours. In laboratory tests —108 degrees Fahr. retards aging almost indefinitely. Aluminum rivets and sheets for forming, particularly of 17S-T and 24S-T alloys, age harden rapidly if not held in their "as quenched" condition by refrigeration to retain maximum workability. Rivets usually are stored at temperatures from 0 to —45 degrees immediately following cold quenching and may be held up to ten days without appreciable hardening. Better physicals are obtained from 24S-T but its hardening characteristics are more critical and it must be refrigerated until applied.

One manufacturer doing considerable forming and stretching of aluminum alloy sheets holds temperatures in a refrigerated cabinet before the forming and subsequent reheating operations. 17S and 24S sheets are placed in a refrigerator at 32 degrees Fahr. or less within five minutes after heat treatment and may be held as long as 24 hours. After removal from the refrigerator, forming should be done within 30 minutes for 17S and 60 minutes for 24S or the alloy must be reheat treated. Heat treatment, depending on the gage and alloy varies between 10 and 60 minutes at temperatures between 910 and 950 degrees Fahr. Material is drawn down to approximate shape on one or two dies, heat treated again and stored in the refrigerator before final forming or stretching operation. In this way wrinkles or spring back are avoided.

Holding aluminum alloys at subzero temperatures does not in any way affect their properties upon return to room temperatures; it merely arrests or slows down the transformation resulting in age hardening which continues at a normal rate when returned to room temperatures.

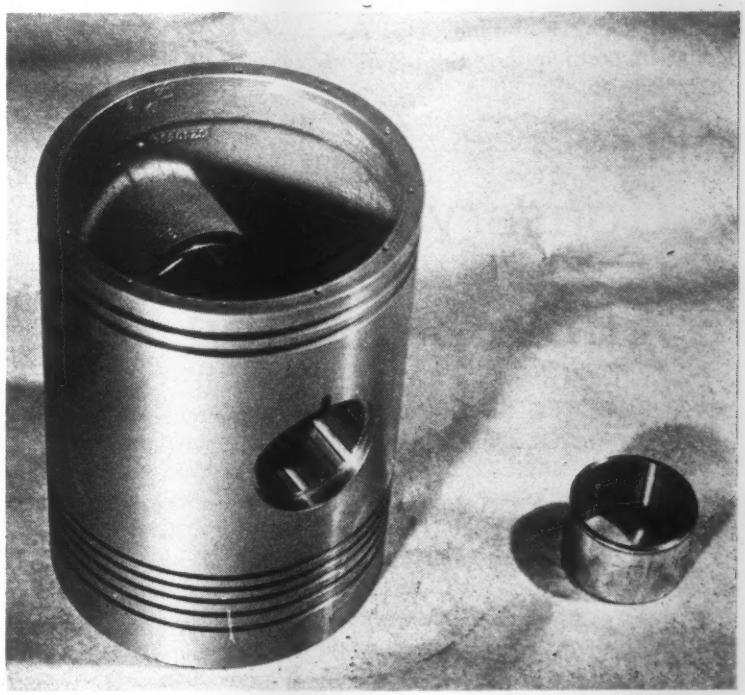
Facilitates Assembly

Expansion fits wherein the male member is shrunk by lowering its temperature and then allowed to expand in assembly has marked advantages for many applications over shrink fitting by heating of the female part. It is especially advantageous for hub and shaft assemblies wherein the shaft is relatively small compared with the mass of the hub, often increasing rate of production. Range of temperatures usually employed is between —50 and —90 degrees Fahr.

Often both shrink and expansion fittings are

Fig. 6—Assembly which formerly required an arbor press is now made by hand by cooling plug and heating the strut. Scoring which resulted previously is obviated by new method

Fig. 7—Below—Bronze SAE 64 wristpin bushing is expansion fitted in diesel piston by shrinking bushing .005-inch



employed to advantage. As an example, one aircraft manufacturer utilizes a Deepfreeze chilling unit, *Fig.* 3, in conjunction with normal heating to speed the assembly of a plug into a landing strut. The plug, 3.880-inch in diameter, is shrunk .0026-inch in a temperature of —120 degrees while the part having a bore of 3.875-inch is subjected to a bath of 450 degrees Fahr. and expanded .005-inch. The plug is then easily inserted by hand, as shown in *Fig.* 6, resulting in a permanent assembly. Total time for the entire operation is approximately ten minutes. Former method of only heating the female part with torches was unsatisfactory because the heat was not sufficiently intense to provide necessary expansion. For this reason the parts were assembled in an arbor press, producing scratches on the mating surfaces which might result in fatigue failures in service.

Another manufacturer uses a similar mechanical refrigeration unit to shrink 4½-inch diameter steel tapered roller-bearing races .003-inch for insertion in a casting. Time was cut to one-half minute in contrast to former method of using dry ice and kerosene, requiring one-half hour to cool the kerosene.

Crankshaft Utilizes Expansion Fits

Crankshafts manufactured for Wright cyclone, 14-cylinder radial type engines shown in *Figs.* 4 and 5 utilize four expansion fits in assembly. Manufactured by Ohio Crankshaft, Inc., the shafts have a 2¾-inch diameter steel plug expanded into the center section of the crank arms. Plugs, shrunk .002-inch in a refrigerated cabinet at —35 degrees Fahr., are inserted easily by hand, obviating any scoring liable to cause fatigue failure or oil leakage.

Dowel pins are fitted similarly into the center section of the center bearing bracket face. Two pins are inserted on both sides of the bracket, each about ⅜-inch diameter and ¾-inch length. Shrinkage is approximately .003-inch and pins are inserted by a driver. Also counterweight hole plugs about 1¾ inches in diameter are shrunk .002-inch and inserted in cheek of counterweight by an arbor press. Plugs are the same type of steel as the shaft, being a chrome-nickel steel, and are used for holding in position the brass counterweight plates.

Two oil jets are fitted into the center section of the crankshafts but are not visible in *Figs.* 4 and 5. Shrinkage is about .0003-inch for the jets, one of which is ⅛-inch in diameter and the other 3/16.

Bronze SAE 64 wrist pin bushings are inserted in the diesel engine piston in *Fig.* 7 by chilling in a Deepfreeze unit. The bushing is 3.319-inch in diameter and is shrunk .005-inch for easy insertion. At room temperatures diameter of bushing is .005-inch larger than hole.

In mass production it is possible to have special fixtures embodying refrigerant-evaporating coils in which the part can be automatically inserted and removed for assembly at the desired time. These coils are of economical shape and length for each specific application. Also, a conveyor could pass continuously through refrigerating coils, delivering a steady supply of cooled parts. A vertical delivery conveyor would be most economical for such applications in that heat infiltration would be less than for a horizontal unit.

Advantages of refrigerating electrodes for resistance welding are well known. Increased electrode life as well as production of better and more consistent welds results and much work has been done in developing techniques.

Requirements for the production of synthetic rubber are typical of the demands made upon refrigerating equipment. Carefully controlled temperatures with high rates of heat transfer would be extremely difficult to obtain were it not for the precision which may be reached through mechanical refrigeration.

A number of metals pass into a new state known as supraconductivity in the temperature region of liquid helium (—455 degrees Fahr.). According to F. Simon, Oxford University, these metals seem to lose their electrical resistance altogether, being a phenomenon of a magnetic nature. Although this has no importance in practical application, it may at a later date shed light upon the nature of metals and their treatment.

In spite of the progress that has been made with subzero treatment in recent years, much remains to be done to evaluate the observed results in terms of commercial applications. Possibilities seem to be great and a better understanding of the construction of matter, aided by research in the field of low temperatures, will be a big step forward and a benefit to the engineering world.

Conserving Aluminum by Alloy Selection

TO FURTHER the efficient use of aluminum scrap in castings, the accompanying chart has been prepared by the Conservation Division of the War Production Board to indicate possible alloy substitutions by which greater amounts of scrap can be utilized. In this chart sand, permanent mold and die casting alloys are considered separately, and possible substitutions are suggested by four progressively lower purity alloy classifications. These are graduated from left to right, those on the left requiring the greatest amount of primary ingot, those on the right permitting the greatest use of scrap. Each of the four headings also indicates the type of material that may be most advantageously employed and from what sources it preferably should be bought.

The nomenclature used is that most common in the industry, and for clarity nominal percentage compositions also are shown with each alloy on the chart. Alloys enclosed by a double line can be heat treated, those by a single line cannot. In addition, a cross reference to several common specifications which are approximately equivalent appears in TABLES I, II, and III.

In using this chart, two things should be remembered. First, if a satisfactory, less critical substitute material in

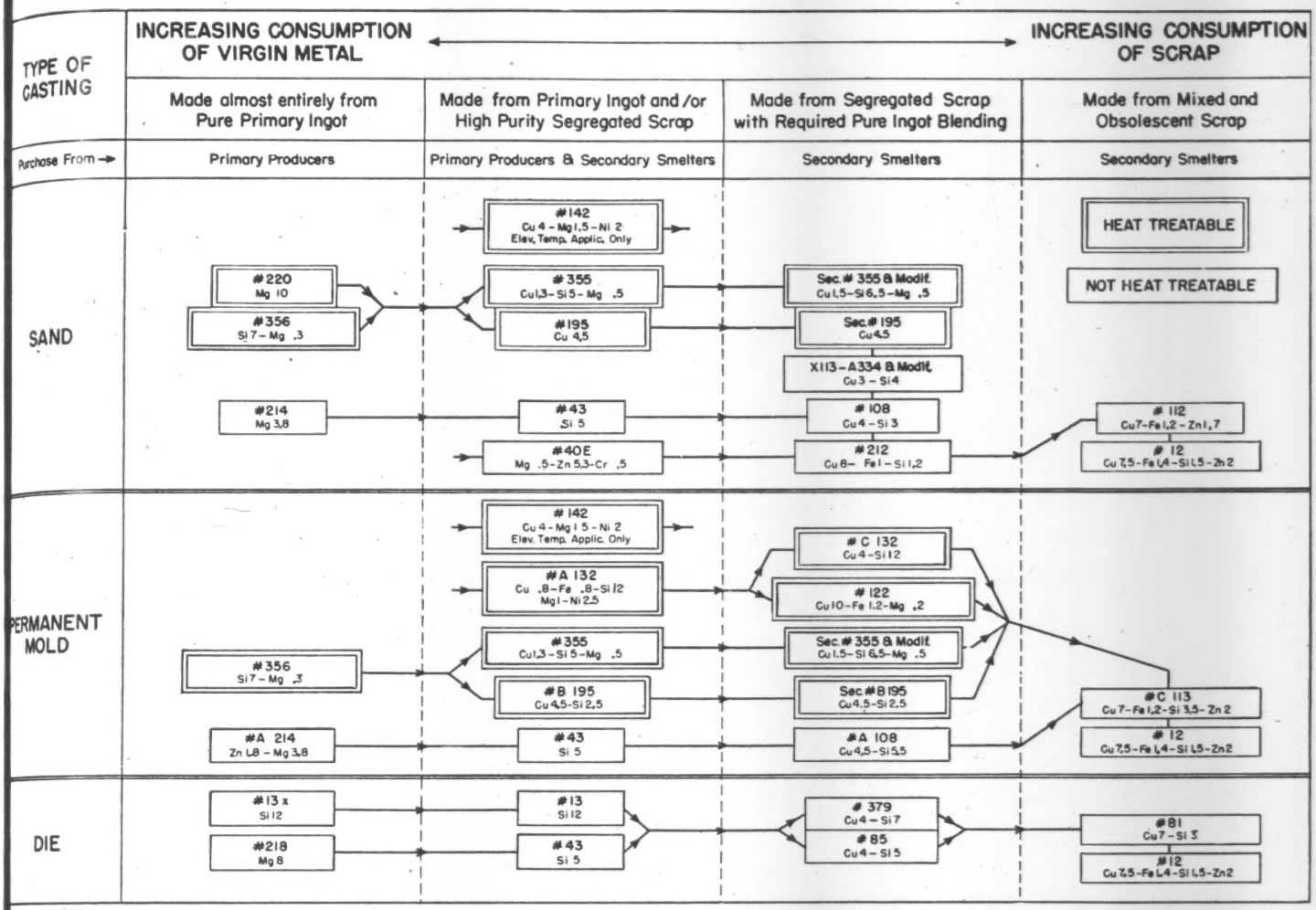

TYPE OF CASTING
INCREASING CONSUMPTION OF VIRGIN METAL
INCREASING CONSUMPTION OF SCRAP
Made almost entirely from Pure Primary Ingot
Made from Primary Ingot and/or High Purity Segregated Scrap
Made from Segregated Scrap with Required Pure Ingot Blending
Made from Mixed and Obsolescent Scrap
Purchase From →
Primary Producers
Primary Producers & Secondary Smelters
Secondary Smelters
Secondary Smelters
HEAT TREATABLE
NOT HEAT TREATABLE
SAND
#220 Mg 10
#356 Si 7 – Mg .3
#214 Mg 3.8
#142 Cu 4 – Mg 1.5 – Ni 2 Elev. Temp. Applic. Only
#355 Cu 1.3 – Si 5 – Mg .5
#195 Cu 4.5
#43 Si 5
#40E Mg .5 – Zn 5.3 – Cr .5
Sec. # 355 & Modif. Cu 1.5 – Si 6.5 – Mg .5
Sec. # 195 Cu 4.5
X113 – A334 & Modif. Cu 3 – Si 4
108 Cu 4 – Si 3
212 Cu 8 – Fe 1 – Si 1.2
112 Cu 7 – Fe 1.2 – Zn 1.7
12 Cu 7.5 – Fe 1.4 – Si 1.5 – Zn 2
PERMANENT MOLD
142 Cu 4 – Mg 1.5 – Ni 2 Elev. Temp. Applic. Only
#A 132 Cu .8 – Fe .8 – Si 12 Mg 1 – Ni 2.5
#355 Cu 1.3 – Si 5 – Mg .5
#B 195 Cu 4.5 – Si 2.5
#356 Si 7 – Mg .3
#A 214 Zn 1.8 – Mg 3.8
#43 Si 5
C 132 Cu 4 – Si 12
122 Cu 10 – Fe 1.2 – Mg .2
Sec. # 355 & Modif. Cu 1.5 – Si 6.5 – Mg .5
Sec. # B 195 Cu 4.5 – Si 2.5
#A 108 Cu 4.5 – Si 5.5
#C 113 Cu 7 – Fe 1.2 – Si 3.5 – Zn 2
12 Cu 7.5 – Fe 1.4 – Si 1.5 – Zn 2
DIE
#13 x Si 12
#218 Mg 8
#13 Si 12
#43 Si 5
379 Cu 4 – Si 7
85 Cu 4 – Si 5
#81 Cu 7 – Si 3
12 Cu 7.5 – Fe 1.4 – Si 1.5 – Zn 2

Table I

Sand Casting Aluminum Alloys

Commercial Specification Alloy	Federal QQ-A-601 & E-QQ-A-601 Class	Army Ord. AXS 784 Class	Navy 46-A-1 (INT) (5/1/42) Class	Aeronautical Number	S.A.E. No.	A.S.T.M. B 26-42 T Alloy
220	..	..	..	AN-QQ-A-392-2	324	....
356	3	..	3	AN-QQ-A-391-2	323	SG1
214	5	..	5	AN-QQ-A-402-2	320	G1
142	6	..	..	AN-QQ-A-379-2	39	CN21
355	10	..	..	AN-QQ-A-376-2	322	SC21
195	4	..	4	AN-QQ-A-390-2	38	C1
43	2	..	2	AN-QQ-A-405-3	35	S2
40E	..	..	1	..	...	ZG41
Sec. 355 and Modifications	..	..	..	..	....	....
Sec. 195	13	13	4a	AN-A-5	E-325	C2
X113-A334 and Modifications	14	14	..	AN-A-4	E-326	....
108	8	..	..	AN-QQ-A-397-2	...	....
212	9	..	..	AN-QQ-A-399-2	36	CS21
112	..	15	..	..	33	....
12	..	15	..	..	33	CS22

Table II

Permanent Mold Aluminum Alloys

Commercial Specification Alloy	Federal QQ-A-596 Class	Army Ord.	Navy 46-A-15 (INT) (2 1/42) Class	Aeronautical Number	S.A.E. No.	A.S.T.M. B 108-41T Alloy
356	8	..	8	..	323	SG1
A214	..	..	..	..	...	...
142	3	..	3	AN-QQ-A-379-2	39	CN21
A132	9	..	9	AN-QQ-A-386-2	321	SN41
355	6	..	..	AN-QQ-A-376-2	322	....
B195	4	..	..	AN-QQ-A-383-2	380	CS4
43	7	..	7	..	35	S2
C132	..	..	..	..	...	...
122	2	..	2	..	34	CG1
Sec. 355 and Modifications	..	..	6	..	...	...
Sec. B 195	..	..	4	..	...	...
A108	5	..	5	..	...	SC1
C113	1	..	1	..	33	C3

some other field can be used, even the lower grades of aluminum should be avoided. Second, if high mechanical properties, specific physical properties, maximum resistance to corrosion or particular casting characteristics inherent in an alloy toward the left of the chart are not essential, it is a contribution to the war effort to use an alloy nearer the right.

With respect to special characteristics, Alloy No. 142

Table III

Die Casting Aluminum Alloys

Commercial Specification Alloy	Federal QQ-A-591 Class	Army Ord. No.	Navy 46-A-14 (INT) (2/1/42) Class	Aeronautical Number AN-QQ-A-366-4 Class	S.A.E. No.	A.S.T.M. B 85-42 & EA-B85 Alloy
13X	2	...	2	A1-13X	...	....
218	7	...	7	A1-218	...	....
13	1	...	1	A1-13	305	V
43	3	...	3	..	304	IV
A379	10	AXS 679 (Rev. 3)	..	A1-85X	E306 E308	LXXIX-B LXXIX-A
85	5	...	5	A1-85	307	VII-A
..	..	...	..	..	...	VII-B
81	4	...	4	..	312	XII

occupies a unique position. Because of its nickel content it is not a desirable substitute for other alloys; however, for certain high temperature uses suitable alternative materials are not available. It should be used only where its unique characteristics are essential.

In reading the chart it should be noted that, because of directives issued by WPB, some of the alloys in Column 2 are available from the secondary smelters only in limited quantities.

Aircraft Experience Aids Industrial HYDRAULICS

Part II

By Lieut. Commander Harry J. Marx, U.S.N.R.*

Bureau of Aeronautics, Navy Department

PUMPS for aircraft hydraulics must be light in weight, compact and highly efficient. Delivery of oil must be as free of pulsations as possible, and the pump must be capable of operating under high speeds without heating excessively under constant operation while using a low-viscosity fluid with low lubricating qualities. It must operate effectively throughout the wide temperature ranges indicated in the previous article, and under atmospheric conditions ranging from sea level to 40,000 feet altitude without cavitation or air inclusion.

Because in most cases the pump is directly mounted on the engine and is, therefore, subject to the engine's operating speed, means must be provided either in the pump itself, or by an external unit, to unload the pressure in the pump and to pass the fluid directly to the reservoir at no appreciable pressure. At the same time, system pressure must be maintained so that high pressure is always available when actuation of the hydraulic mechanisms is started. The variable delivery type of pump eliminates the pressure regulator or unloader valve, system relief valves and accumulators, pressure in the system being maintained at its peak at all times while the pump runs free when the system is not in operation. Variable delivery automatically regulates the quantity of flow to suit the requirements of operation.

Industrial Pump Requirements Varied

It is important to emphasize the basic differences in pumps required for the industrial and aircraft fields. The extensive range of applications in the field of industrial hydraulics results in a wide range of types of pumps. Capacities of the systems vary from light mechanical and automatic operations to fields of heavy tonnage, *Fig.* 7. Operation may be constant or intermittent. Horsepower requirements vary from small fractions to 200 or even more for special purposes. In comparison to aircraft the driving speed is low, usually 1800 revolutions per minute or lower. Delivery may be as high as 1000 gallons per minute at pressures varying from 150 to 15,000 pounds per square inch.

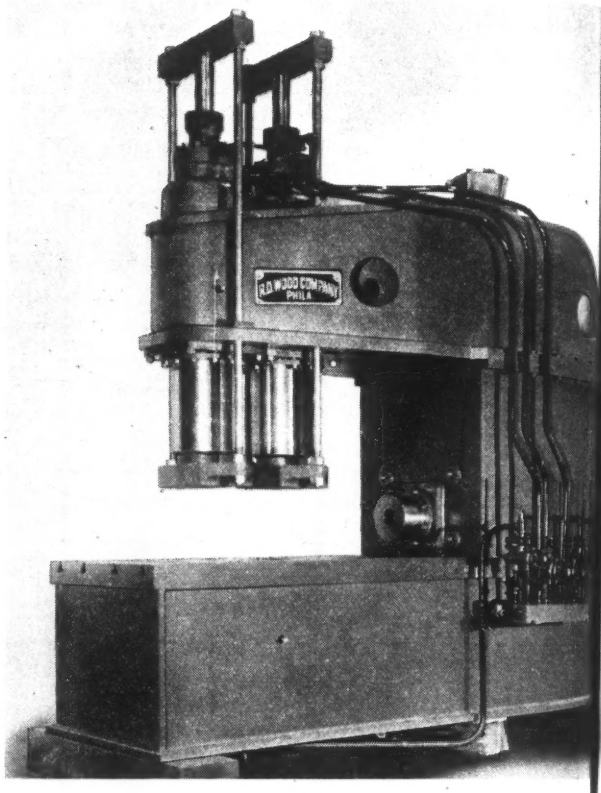


Fig. 7—Typical of industrial hydraulics applications is this 300-ton sectional flanging press, with control valves grouped on right side

For aircraft the picture is considerably different. Although there are various developments and variations, some still in the experimental stage, aircraft hydraulics is now standardized in two operating pressure ranges, namely 1000 and 1500 pounds per square inch systems. Automatic pilots operate at lower pressures but these constitute a separate field of investigation. Aircraft pumps are normally rated on a basis of 1500 revolutions per minute although they may run at about 4000 revolutions per minute when the throttle is open. Under normal operation they require about two to eight horsepower input, and as high as fifteen in the larger capacities. Capacities vary between one and eight gallons per minute. Volumetric efficiencies vary from 90 to 97 per cent although these will drop if the pressures go over 1500 pounds per square inch. The average pumps at present in use vary from three to six pounds in weight.

Aircraft hydraulic systems in this country utilize two types of pumps, positive rotary (constant delivery) which includes the gear and vane pumps,

* Opinions or statements contained in this article are those of the author and should not be construed as reflecting the official views of the burerau of Aeronautics.—Ed.

and reciprocating piston pumps which may be either constant or variable delivery.

Included with the first type are the gear pumps as made by the Pump Engineering Service Co., including their new development, the pressure bushing type, (*Fig.* 5, M.D. for Sept., Page 94) and the Gerotor type as made by the Eclipse Division of Bendix Aviation Corp. The second type includes rotary axial pumps as made by Vickers Inc. and Pump Engineering Service Co., also the rotary axial pumps with the variable delivery feature as made by the Dowty Equipment Co. Other types such as the Sundstrand are now coming into the picture, due to special requirements and the introduction of additional production facilities.

Poppet Valves Preferred for Control

Control valves used for aircraft hydraulic systems differ little in general design from those used in the industrial field except for weight and compactness. Originally the use of slide valves was common but, due to the temperature range encountered and the resultant critical tolerance requirements coupled with the necessity for interchangeability of parts, serious production problems developed and their use in aircraft systems has not been encouraged. The majority of directional control valves are of the poppet type and, in fact, the Bureau of Aeronautics and the Army Air Force have standardized on two of these types, namely the "in-line" and the "radial" type, *Figs.* 8 and 9. Each type is listed in three capacity ratings, 3½, 6 and 16 gallons per minute with ports for ⅜, ½ and ¾-inch tube lines. Specifications definitely limit the pressure drop, leakage, operational torque, and burst pressures.

Whereas the industrial field has developed numerous composite units incorporating flow restriction, check valves and similar features, this has been discouraged for aircraft use in order to simplify maintenance. Special designs are rarely applicable in more than one airplane installation and therefore cause an increase in the number of spare parts that must be carried in stock. Pressure drop limitation and control of flow capacity results in more efficient design and better performance in operation.

Industrial hydraulic systems do not have extensive use for open-center valves where the pilot puts the lever in a position that by-passes oil back to the reservoir. This system does not require pressure regulators and has been in limited use in aircraft. There is a decided indication that it will be used to a greater extent in the future, particularly in systems utilizing a 3000-pounds per square inch pressure.

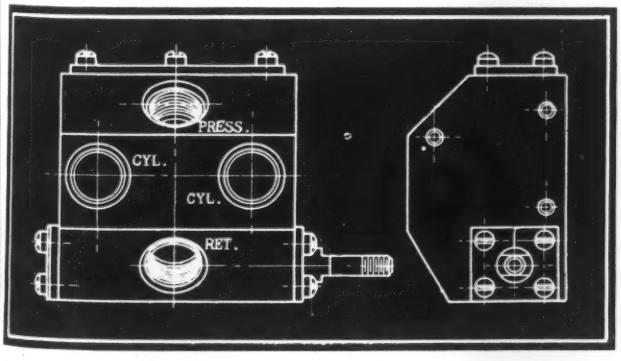


Fig. 8—Directiona control valve of the in-line type, standardized for aircraft, has capacity of six gallons per minute. Two other ratings also are standardized

The diversified types of applications and the special design requirements for actuating cylinders used in both industrial and aircraft systems result in such a wide variety of designs that close comparison is somewhat difficult. As is the case with other units, the chief distinction between the two fields is of course the weight reduction and compactness of design when used in aircraft. *Figs.* 10 and 11 show typical designs. In aircraft hydraulic cylinders such features as locks, dashpots or snubbers, shuttle valves, pressure relief, and sequence operation may be incorporated in the cylinder design. Some cylinders are designed for spring return and therefore fluid pressure is applied only in one direction.

"Industrial hydraulic cylinders frequently are used on large, expensive, elaborate machinery. They often are located in inaccessible spots. Shutdown of machinery for maintenance, repair, replacement of parts, or even adjustment of packings should be required only rarely or never. The user expects the piston packing to be dead tight and this has been found not only possible but practical. However it requires extreme accuracy and highly finished surfaces. Maintenance of these conditions is accomplished by using thick cylinder walls of centrifugally cast semisteel, steel pistons and piston-rod gland packing of a self-sealing type, either entirely nonfibrous or a combination of leather and nonfibrous. Consequently life is long, leakage is low, and the packing gland can be nonadjustable, resulting in low friction loss.

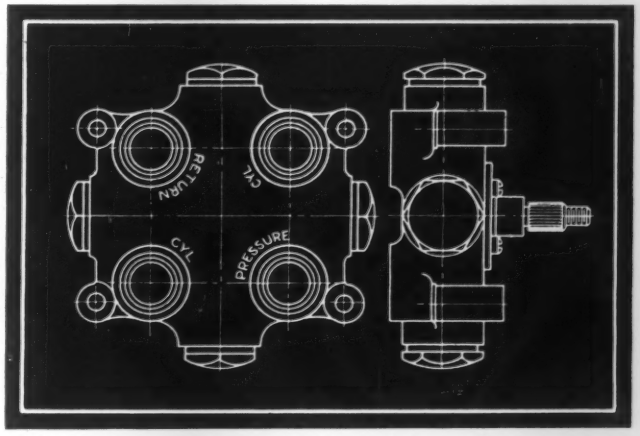


Fig. 9—Radial type hydraulic directional control valve, like the in-line type, employs poppet valves

"The aircraft designer usually knows just what a cylinder is supposed to do and the conditions surrounding its application. In the majority of cases designers of units for industrial applications have, at best, a vague idea of the use and surrounding conditions, hence factors of safety must be liberal, never less than five to one. Cost is a much more important consideration in the design of industrial units than with aircraft units. Weight is certainly the least important consideration to the industrial designer and is probably the most important consideration with the aircraft designer.

"Selection of pressure has an effect on all other considerations. The designer of industrial equipment must

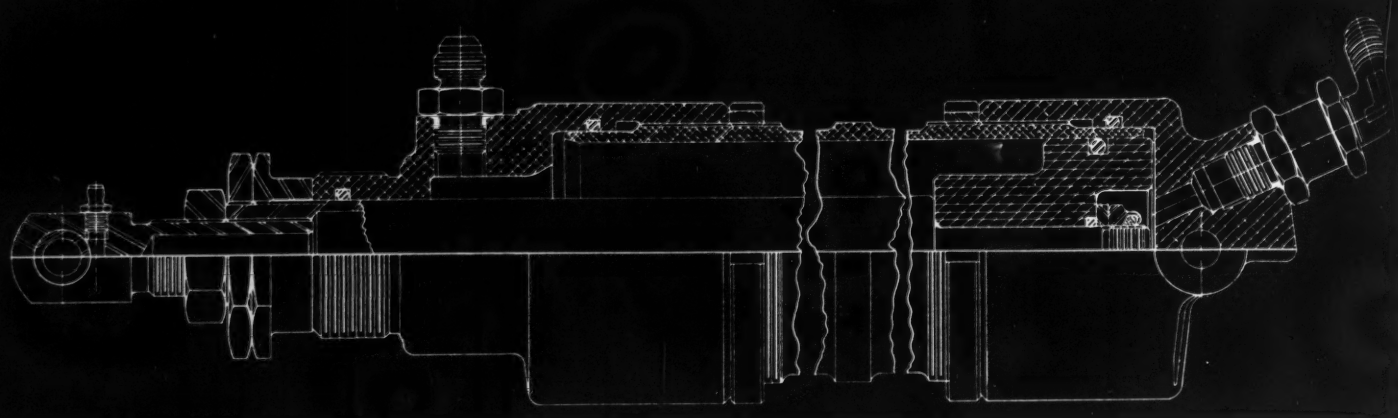


Fig. 10—Above—Typical aircraft actuating cylinder, 2½-inch bore, has stroke approximately 21½ inches

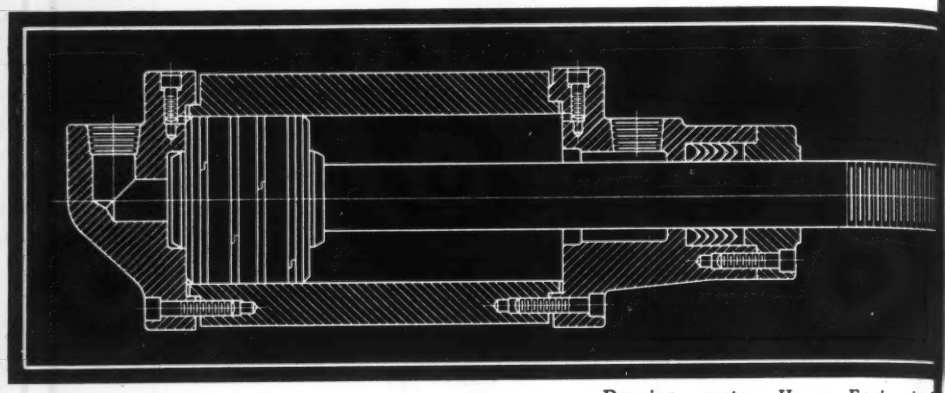


Fig. 11—Right—Proportions of industrial actuating cylinder affords interesting contrast to those of aircraft cylinder in illustration above

—Drawing, courtesy Hanna Engineering

bear in mind the cost and availability of pumps for various pressures. High-grade pumps rated for 1000 pounds per square inch are available at a moderate price. Pumps capable of 2000 pounds are about four times as expensive, while those for pressures in excess of 2000 are eight or more times as expensive. Higher pressures make for lower efficiencies and reduced factors of safety. Since first cost in pump, valves and other accessories usually more than cancels any saving in first cost that might be made in the cylinder by reduction in size with increase in pressure, the industrial cylinder is usually rated at 1000 or 1500 pounds per square inch."

The foregoing comments by J. C. Hanna of the Hanna Engineering Works illustrate the industrial side of the story. The aircraft field is confronted with different problems. Service life is more limited and periodic overhaul is customary, but in these units the problem of wide temperature range again results in tolerance problems. Packings have been made of synthetic rubber, generally of the chevron or cup type. Now toroid rings are being used to a great extent due to simplicity of design and to facilitate production. Metal glands of the French Olaer type are being studied and tested. Leather chevron types used in conjunction with synthetic rubber have proved effective in sealing where subnormal temperatures are encountered.

Cylinders are steel or aluminum alloy, piston rods are usually steel due to the loading, while piston heads are steel, aluminum alloy, bronze or even phenolic compounds. Cylinder walls vary from one sixteenth to one quarter-inch in thickness. Tolerances and concentricity must be closely maintained and finishes kept to not more than five microinches, profilometer reading. Bearing areas must be adequate to carry compression, bending or vibration loads. Packing rings cannot be considered as part of the bearing area. Wiper rings to avoid carrying foreign matter into the cylinder are necessary where cylinders are installed in locations exposed to dust and dirt.

Use of universal joints or self-aligning bearings at the ends is desirable in order to eliminate bending loads. Efforts have been made to standardize cylinder design but to date this has not been found practicable.

Unloader Valves Maintain Pressure

The majority of aircraft hydraulic systems have been using pressure regulators, sometimes called unloading valves, to maintain pressure within predetermined limits when fluid is delivered by a constant displacement pump. When the system pressure reaches the upper limit the fluid is by-passed back to the reservoir at a low pressure, thus relieving the pump of all but a small percentage of any load.

Regulator units are based on a rated flow of ten gallons per minute but designs for larger flow rates are under consideration at the present time. Numerous other designs and makes of pressure regulators were formerly used but due to the necessity of rigid requirements they have fallen by the wayside. Temperature variations are apt to affect the operating limits, internal leakage, etc. The close precision in machining and the extensive testing required have discouraged many manufacturers.

Schematic diagram, *Fig.* 12, shows a typical aircraft hydraulic system and indicates the connections to the pressure regulator valve. Attention is called to the fact that this shows an Electrol regulator and no drain return port is used as would be the case with the Vickers unloader.

The aircraft accumulator (or pressure storage tank) can be likened to a storage battery. Inasmuch as it is a reservoir for storing power, it can be called upon as an auxiliary unit to assist the functions of the system or to serve as an emergency power source if the pump is rendered inoperative. Potential energy stored in the accumulator can be utilized to operate any unit in the system automatically when needed. The size or capacity should be adequate to operate every hydraulic component at least once, as well as to hold sufficient fluid under pressure to operate the brakes often enough to insure a safe landing.

Accumulators Precharged with Air

Although applied to aircraft only since about 1935, accumulators have been used for many years in industrial applications where piston and cylinder types, employing weights or springs instead of precharging with air, have been extensively used. Principle of the aircraft type, as illustrated in *Fig.* 13, uses a compressible medium such as air with a synthetic rubber bag or a diaphragm as a separator between air and oil to prevent absorption or mixture. The accumulator illustrated in *Fig.* 13 is the Simmonds-Olaer. Vickers accumulators are made with

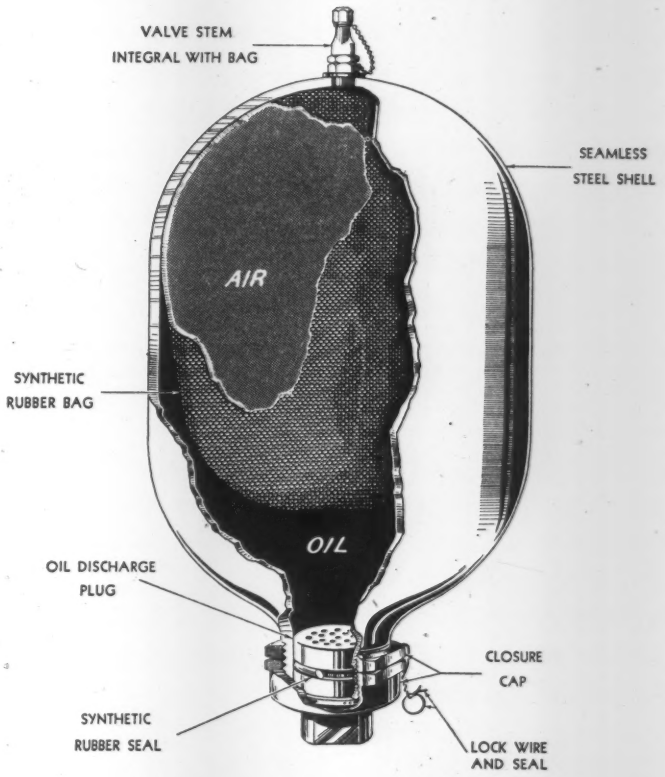
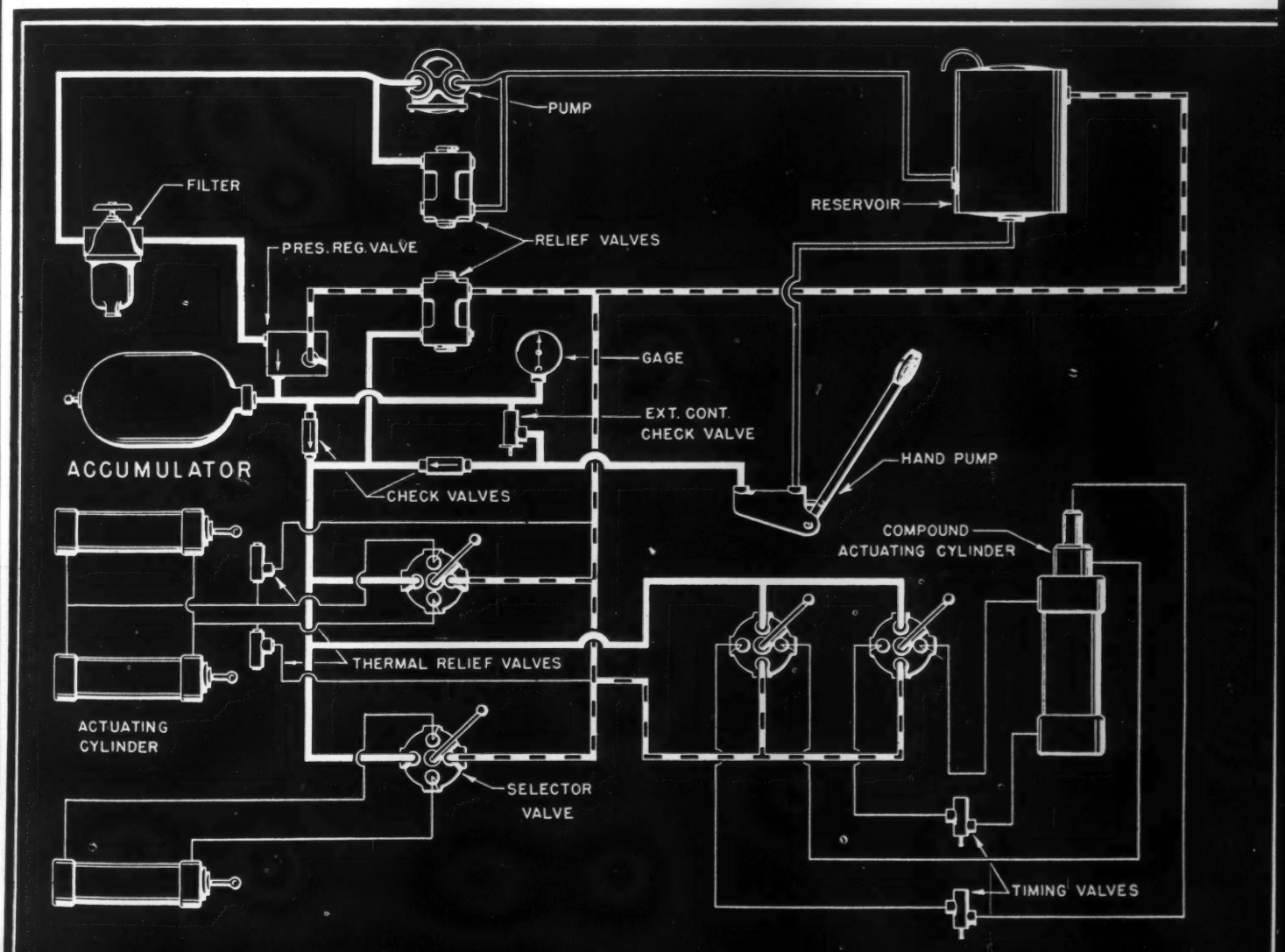


Fig. 13—Above—Cutaway view of typical aircraft accumulator illustrates principles of operation

Fig. 12—Below—Aircraft hydraulic circuit diagram indicates connections to the pressure regulator valve



diaphragms instead of bags.

An interesting feature in the use of accumulators is the effect of temperature on pressure, *Fig.* 14. At a preload pressure of 600 pounds per square inch there is a change of over 150 pounds when the temperature is dropped from 70 to —65 degrees Fahr. For this temperature drop the pressure change is more than 25 per cent .

Whether the system is industrial or aircraft type, there is one requirement that is identical for all hydraulic systems: Absolute cleanliness is essential for satisfactory operation. Both types require adequate filtration. The aircraft field is best acquainted with the metal-edge type of cleanable filter. This strained out all dirt having a thickness of more than .0035-inch but any scale or flake that was thin enough might get through. As a result what is now known as micronic filtration was developed. A filter of this type is shown in *Fig.* 15. Reservoirs with filter elements incorporated have eliminated the need for separate filter units. These elements are usually of impregnated paper construction and particles greater than .0005 by .0005-inch are prevented from getting into the system.

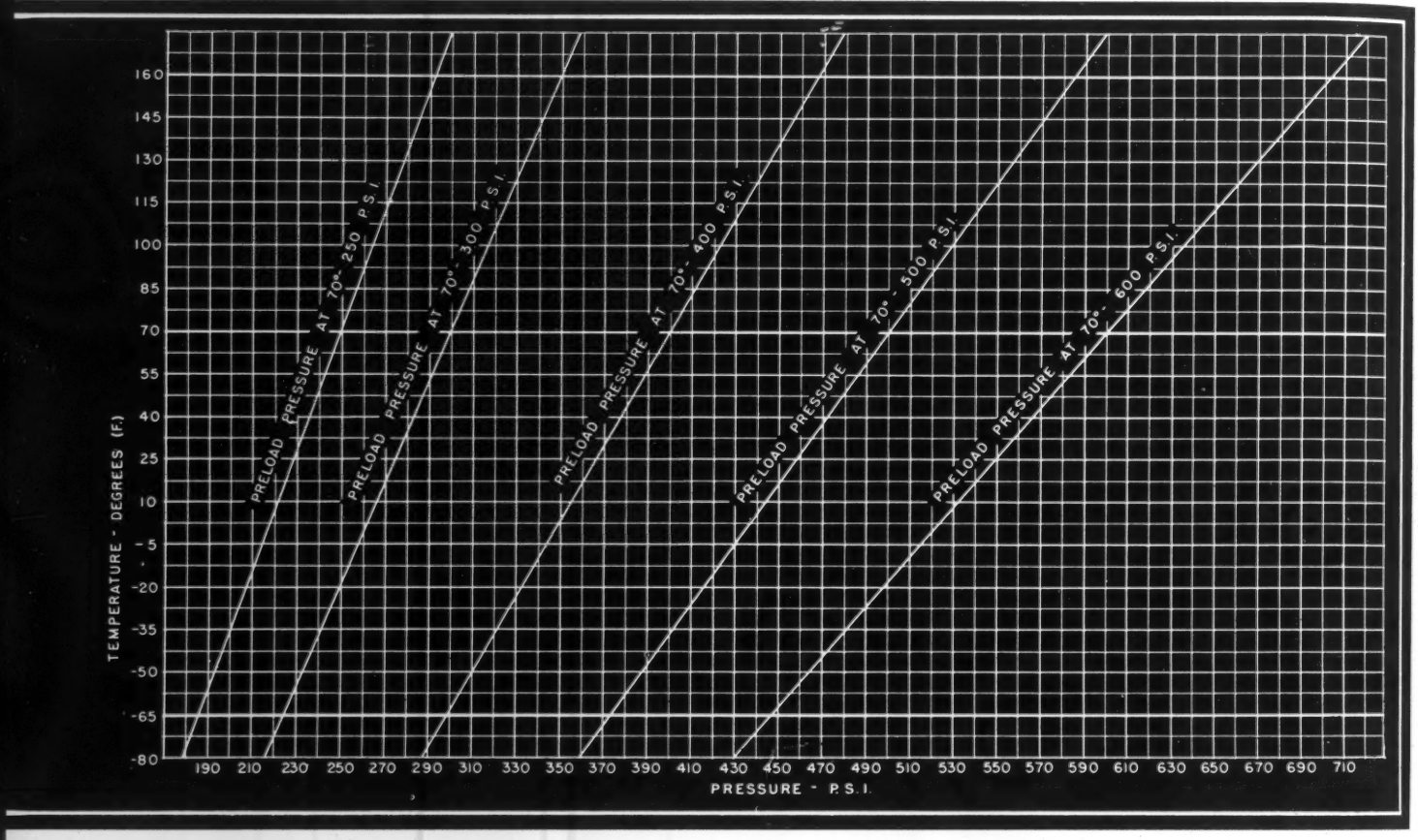


Fig. 14—Above—For preload pressure set at 70 degrees, changes in temperature materially affect pressure in accumulator

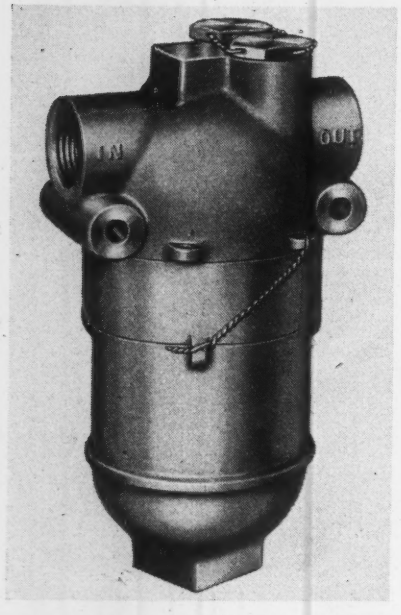


Fig. 15—Left—Filter assembly incorporates replaceable elements of the micronic type

—Photo. courtesy Purolator Products Inc.

Miscellaneous items such as relief valves, check valves, sequence valves, shuttle valves, restrictors, etc. could be discussed as individual items but the foregoing general comments cover all of them. Compactness, weight, operating temperature range requirements, simplicity and standardization are primary considerations. In postwar design the effect of aircraft hydraulics on industrial installations is bound to have consequences of great interest to designers of all types of machinery. Developments in both fields merit their closest attention.

The author wishes to express his appreciation for the cooperation of the following companies in addition to those already mentioned: Adel Precision Products Corp.; Aeroquip Corp.; American Engineering Co.; Baldwin-Southwark Division; Dorr-Patterson Engineering Co.; Globe Hoist Co.; Goulds Pumps Inc.; Greer Hydraulics Inc.; E. F. Houghton & Co.; Hydra-Motive Division; Hydraulic Machinery Inc.; Hydro-Power Systems Inc.; C. B. Hunt & Son; Logansport Machine Inc.; Parker Appliance Co.; Racine Tool & Machine Co.; Geo. D. Roper Corp.; Watson-Stillman Co.; Weatherhead Co.; Yarnall-Waring Co.; Zenith Associates.

MACHINE DESIGN

Editorial

Advances in Materials Presage Bigger Problems, Greater Scope

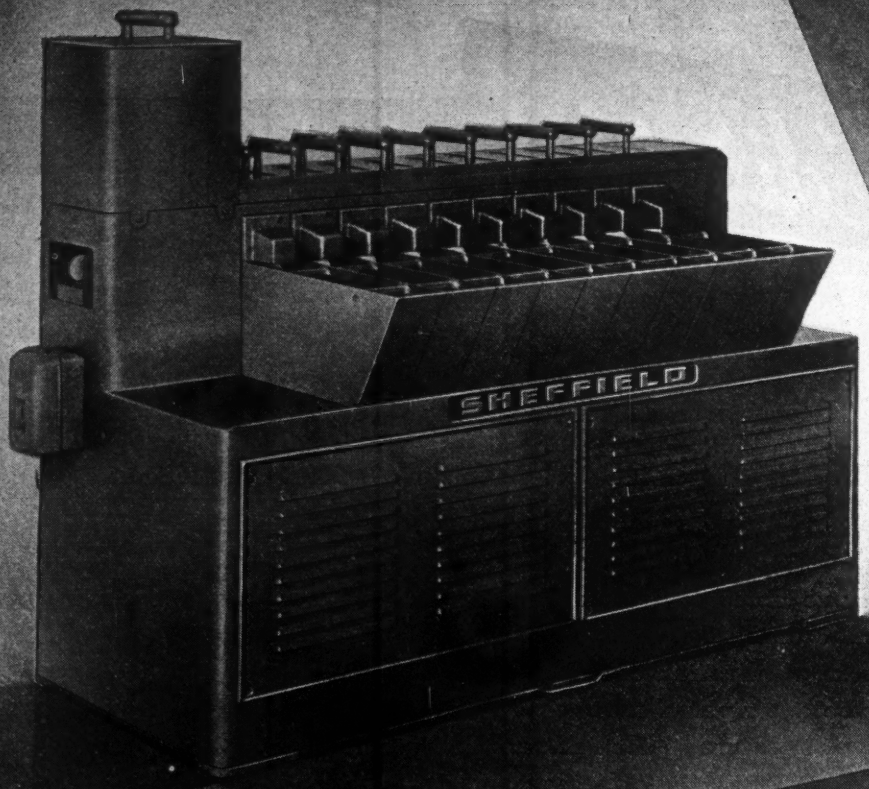
ENCOURAGING facts have come to light regarding the use of carbon and low alloy steels that probably would not have been disclosed but for experience gained in application of these steels to wartime equipment. As a result, it may be anticipated that wider use of such steels will be made and that no attempt to return to the indiscriminate employment of higher alloys is likely to take place either during the war or after.

At the same time, with the demand for the higher alloy steels as used in the production of actual war equipment tending to ease off, designers shortly may feel they are in a position to specify such alloys for purposes for which they are eminently suitable but for which they recently have not been available except on high priority. Inasmuch, however, as war requirements for materials are subject to constant and often drastic change, consideration still should be given to NE substitutes or other alternatives rather than to make a change now and be compelled to return to the substitute material again in the near future.

It is impossible, with the materials picture changing so rapidly, to chart a course capable of meeting all eventualities. Even the NE series just mentioned—commendably set up to make the best of a tough situation—could not be expected to prove entirely satisfactory. That results have been good, but not completely so, is being proved by a number of cases in which users of these steels plan to return to their original specifications, or to adopt new ones, immediately conditions become sufficiently stable.

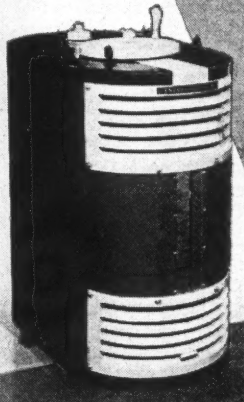
New methods of testing and specifying steels for individual purposes, particularly the Jominy end-quench test, ultimately will go far toward clarifying the problems confronting the metallurgist and the designer. Until these methods gain wider acceptance, however, selection of alloys or changes in specifications necessarily will be made primarily on the basis of chemical composition and general physical properties. It is because of this condition that the editors of MACHINE DESIGN feel gratified in being able to present the comprehensive directory of materials included as a supplement in this issue.

L. E. Jermy

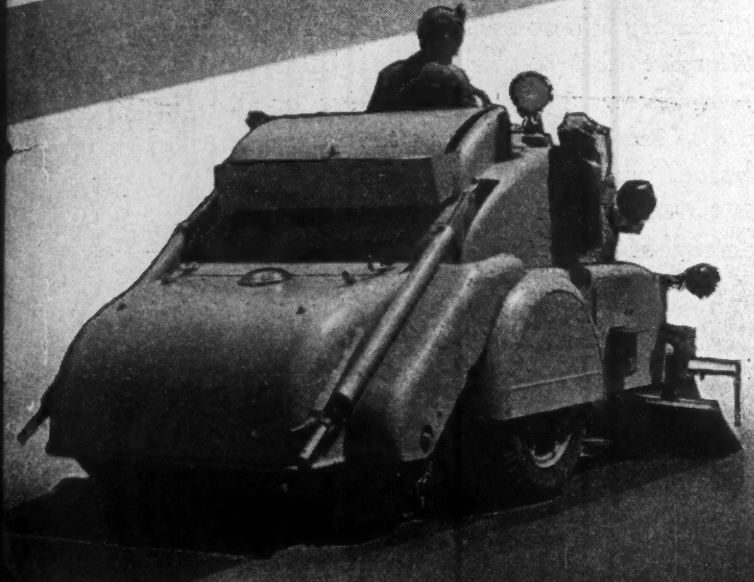


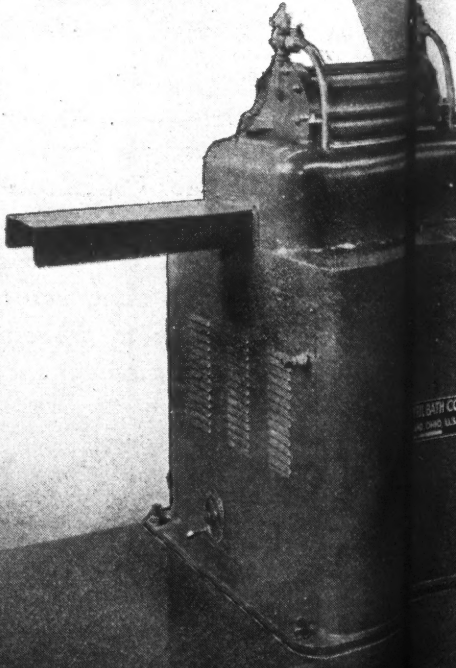
Left—Master-set and locked by screws, the gage strips of Sheffield's ball bearing checker are steel with tungsten carbide inserts. Bearings are fed for gaging from hopper by walking beam, the vertical and horizontal motion of which is imparted by plate cams which in turn are actuated by belt drive from motor

Right — Stepless current control, finger-tip adjustment and fan-forced ventilation are utilized in General Electric 500-ampere outdoor welder. Drip-proof construction and sealed indicator window protect against rain, sleet and snow. All internal parts have special corrosion-resistant finish



Below—Chain-driven vane type hydraulic pump with chromium-plated piston rod is utilized in Austin-Western road sweeper. Driven from input shaft of main transmission at constant speed, the rear brush is operated by roller chain, the gutter brush through bevel gears. Gear pump supplies pressure for water spray, the intensity being controlled by shut-off cocks which by-pass surplus water through brass piping back to tank fabricated of copper-bearing steel





Left—Two positioning motors, operating on a novel variable reluctance principle, move the pen in TelAutograph's A.C. telescriber which transmits written data. Selection of any one or any combination of stations is accomplished by pushbutton and relay control. A small shaded-pole motor automatically ejects each completed message

Above—Drive and hoist gears of Yale 6000-pound capacity platform and crane truck are drop forged chrome nickel steel and operate in oil bath. Heavy plate and bar steel of frame is electric welded into unit structure. Thrust load of crane is carried on large tapered-roller bearing

Machines Behind the Guns

(For new machine listings, see page 294)

Right — Straight-line reciprocated sanding pad of Lintern Nedco sander is driven from motor gear through cam-activated plate which is ball bearing mounted. Spiral bevel type motor gear and pinion are molybdenum steel, case is cast aluminum

Below — Patented recuperation principle is employed to fire by gas or oil the two outside pots of Holden high-speed heat-treating unit. Heat in ceramic center pot is generated by resistance of the molten bath to electric current passing between immersed electrodes. Outside pots are removable and interchangeable

Left—Table of Bath contour bender is gear and pinion driven through variable-speed unit at speeds ranging from ten to thirty feet per minute at the perimeter. Sturdily constructed shaping-slide ram is driven by air cylinder which has an 11,000 pound capacity and twenty-eight inch stroke

Design Roundup

Improved Treatment for Shell

Great many varied reports have been circulating relative to the success—or lack of success—of steel cartridge cases designed to relieve the shortage in brass. One of the principal difficulties has been attributed to the protective coatings on the surface of the cases which caused them to stick in the gun barrels upon continued rapid firing.

This objective now is being overcome by electroplating the steel cases with zinc followed by a chromating treatment which involves immersing them in a solution containing 200 grams of sodium dichromate and 6 to 9 cubic centimeters of concentrated sulphuric acid per liter of water. The same process is well adapted to treatment of zinc die-cast and zinc-coated machine parts which normally develop a white oxide film when subjected to entrapped moisture.

Electronics Strides Ahead

Applications of electrons hold unlimited possibilities and are expected to influence profoundly the design of machines in the postwar period. This trend, well under way for several years, received a setback with the war as restrictions were imposed upon the manufacture of many types of industrial machinery.

Meanwhile, basic research has continued unabated. At the same time, applications of electronics to equipment required for the waging of war—for example, radio and radar—have introduced new conceptions of the worth and utility of the science. Thousands of young Americans will emerge from their military service with a familiarity of electronics that will go along with them into peacetime pursuits in industry. This favorable circumstance is not to be overlooked in future electronic progress.

Industrial applications, such as welding-machine controls, induction heating, speed controls, power conversions, and the like, are well known. Their first utilizations effected basic changes in equipment design, and their further adaptations in years to come will produce similar results.

Variable-speed control for drives with alternating-current motors, through a source of variable-frequency power, should be extremely useful in operation of high-speed machines. Likewise, the recent application of high-frequency, high-power oscillators and mercury-vapor rectifiers with photoelectric regulators to control the flow of tin on tin plate has wide potentialities. Among other devices about to make their appearance is an electronic method for demagnetizing magnetic chucks to facilitate removal of work from the chucks.

Selecting Steel Economically

One of the most important assets to material specification practice being developed at an accelerated rate as a result of the war is now one of industry's biggest headaches. Brought on by the necessity for substitution in critical alloys, the search for steels which will meet stiff physical requirements without critical components has resulted in a new technique which probably will persist after the war.

Supplanting, or rather augmenting, the simple-to-handle "loaded" alloys will be the less costly but more temperamental low alloy and carbon steels. Specifications will be inclined toward the physical requirements rather than the chemical composition, and the heat-treating facilities of the customer will be taken into consideration. For example, an actuating cam in a packaging machine will be made from steel which will provide the necessary hardenability and ductility at the lowest cost to the fabricator. If that fabricator has good heat-treating facilities and a flexible practice, he can use a lower cost steel and achieve the necessary results. The odd shape of that part has made it difficult in the past to obtain the hardenability required.

Much work has been done since the start of the war—and much more will be done in the months to come—by metallurgists and designers in cooperation, toward the establishment of exact methods for determining these unknowns. Much has also been done and will be done on heat-treating techniques to spread the usability of common steels. A good example of this is the Nelson process, invented by a Californian and reported at the recent meeting of the American Chemical Society, by means of which ordinary 1020 carbon steel gives tensile strength up to 130,000 pounds per square inch and ultimate strength up to 190,000. The steel is quenched at 1700 degrees Fahr. in a solution of 35 per cent sodium or potassium hydroxide at room temperature.

MACHINE DESIGN'S

Materials Work Sheet

Filing Number 9.00

ALUMINUM ALLOY 24S-T

AVAILABLE IN: Sheet, plate, wire, rod and bar, extruded shapes, tubing and pipe, rivets

ANALYSIS: .5 copper; .6 manganese; 1.5 magnesium; remainder aluminum plus normal impurities

PHYSICAL PROPERTIES

TENSILE STRENGTH
(minimum—psi)

Bars	62,000
Flat sheet and plate .012 to .249-inch thk.	64,000
.250 to 1.000	62,000
1.001 to 2.000	60,000
Tubing	64,000

YIELD STRENGTH IN TENSION
(minimum—psi)

Bars	40,000
Flat sheet and plate .012 to .249-inch thk.	42,000
.250 to 2.000	40,000
Tubing	42,000

ELONGATION IN 2 INCHES
(minimum)

Bars (rolled rd., sq., hex., oct. and rectangle)	14
Flat sheet and plate .012 to .020-inch thk.	10
.021 to .051	13
.052 to .128	15
.129 to .249	14
.250 to .500	12
.501 to 1.000	8
1.001 to 1.500	7
1.501 to 2.000	6
Tubing 1¼ to 2 inches diameter:	
.025 to .049 wall thk.	12
.050 to .259	14
.260 to .500	16
Tubing 2 to 8 inches diameter:	
.025 to .049 wall thk.	10
.050 to .250	11
.260 to .500	12

BRINELL HARDNESS
(500 kg. load, 10mm. ball—minimum)

All forms	105

MELTING POINT
(liquidus—deg. F.)

All forms	1,180

TEMPERATURE COEF. OF RESISTANCE
(ohms per ohm per deg. C.)

0 to 100 deg. C.	.0020

SPECIFIC GRAVITY

All forms	2.77

SHEARING STRENGTH
(typical—psi)

All forms	41,000

FATIGUE ENDURANCE LIMIT
(typical—psi)

All forms	18,000

MODULUS OF ELASTICITY
(psi)

All forms	10,500,000

TORSIONAL MODULUS OF ELASTICITY
(psi)

All forms	3,950,000

WEIGHT
(lb. per cu. in.)

All forms	.100

COEF. OF THERMAL EXPANSION
(per deg. F.)

68 to 212 deg.	.0000122
68 to 392 deg.	.0000130
68 to 572 deg.	.0000138

THERMAL CONDUCTIVITY
(at 100 deg. C.—C. G. S. units)

All forms	.28

ELECTRICAL CONDUCTIVITY
(% of copper std.)

All forms	30

ELECTRICAL RESISTIVITY
(microhms per cm.³)

At 20 deg. C.	5.75

PHYSICAL PROPERTIES AT ELEVATED TEMPERATURES

	Temperature in deg. F.					
	75	300	400	500	600	700
TENSILE STRENGTH *(typical—psi)*	68,000	42,000	28,000	14,000	7,500	5,000
YIELD STRENGTH *(typical—psi)*	45,000	35,000	21,000	9,000	5,000	3,500
ELONGATION IN 2 INCHES *(per cent)* Round specimen ½ inch diameter	22	21	25	40	65	100

MACHINE DESIGN is pleased to acknowledge the collaboration of Aluminum Company of America in this presentation.

Materials Work Sheet

BEND RADII FOR FLATS, SHEETS AND STRIPS

Minimum recommended radii for 90-deg. bend in terms of thickness (t) expressed in inches:

Thickness (t)	1/64	1/32	1/16	1/8	3/16	1/4
Radii	1½t to 3t	2t to 4t	3t to 5t	4t to 6t	4t to 6t	5 to 7t

Note: If bending is done in the annealed state or immediately after quenching, this material can be formed over appreciably smaller radii.

SAFE INTERNAL WORKING PRESSURES OF TUBING

Apply formula:

$$P = S - \frac{D^2 - d^2}{D^2 + d^2}$$

in which P = internal working pressure (psi)
S = working stress (psi)
D = O. D. of tube (inches)
d = I. D. of tube (inches)

The working stress of this material (24S-T) at room temperature may be taken as 17,000 psi, based on a safety factor of 4.

To determine the internal working pressures at elevated temperatures, multiply the working stress at room temperature (17,000) by the following factors:

	Temperature Deg. F.				
	75	200	300	400	500
Conversion Factors	1.00	.88	.61	.32	.14

APPLICATION

For parts and structures requiring most favorable strength-weight ratio. Is standard alloy for aircraft sheet, structural tubing, thin extrusions and rolled bar. Must be protected from contact with heavy metals such as copper, tin, brass, bronze and lead to prevent galvanic corrosion under severe conditions such as sea water and marine atmospheres.

CHARACTERISTICS

This alloy is of the same type as the older 17S-T. Its mechanical properties are higher as a result of an increase in the percentage of alloying constituents. It is somewhat more difficult to work than 17S-T in corresponding tempers. When properly heat treated its resistance to corrosion is good, as evidenced by its service history in aircraft including the floats and hulls of seaplanes. In addition to its high strength, it has all the normal characteristics of other aluminum alloys.

FABRICATION

MACHINABILITY:

Good; takes a smooth finish.

STAMPING, FORMING AND DRAWING:

Stamps readily and can be formed not too severely in the heat-treated state (*see Recommended Bend Radii*). Severe forming can be done only with the material in its annealed state or immediately after quenching from the heat-treating temperature. For general spinning and drawing, the softer, more ductile grades such as 2S or 3S will be found easier to work and should be used if their strength is adequate.

FORGING:

Not made for forging.

WELDING, BRAZING AND SOLDERING:

No satisfactory technique has yet been developed.

RESISTANCE TO CORROSION

Although this alloy does not corrode appreciably in dry, clean inland atmospheres, it is customary to protect it with paint coatings usually preceded by anodizing or chemical-dip oxide coating. In marine and highly contaminated industrial atmospheres, joint coatings preceded by anodic or other types of oxide treatments are recommended. Not as corrosion resistant as aluminum alloy 2S (commercially pure aluminum) or the silicon and manganese-bearing aluminum alloys.

CORROSION-RESISTANT FINISHES

Anodic coatings, which can be applied in various colors (by die or pigment adsorption) provide good resistance to corrosion, have high dielectric strength and can be made hard so as to offer resistance to abrasion and durability to the part. For maximum resistance to corrosion, anodic coatings should be sealed with a chromate or other sealer. Electroplated chromium finishes are sometimes applied where corrosion and abrasion resistance is required.

GALVANIC CORROSION

Contact of this alloy with copper, nickel, brass, bronze, monel, iron and steel should be avoided in the presence of salt water or sea coast atmospheres, as these metals are cathodic to 24S-T and the resulting galvanic couple results in accelerated corrosion. Zinc and cadmium-plated parts, however, can safely be used in contact with it.

HEAT TREATMENTS
(for 24S to produce 24S-T)

Either a fused salt bath or an air-chamber furnace of proper design may be used. If salt bath is used, salt must be thoroughly rinsed from the parts after treatment. Temperature for the soaking periods below are for the parts being treated, not the furnace.

Thickness (inches)	Time	Temperature
up to 1/32	30 min.	910 deg. F.
over 1/32 to 1/8	30 min.	to
over 1/8 to 1/4	40 min.	
over 1/4	60 min.	930 deg. F.

After soaking at temperature indicated, a rapid quench in water kept below 90 deg.F. is essential to produce maximum corrosion resistance. Use ample volume of water and space parts generously during soaking and quenching.

DATA ON STOCK FORMS

TABLE I
Commercial Thickness Tolerances
(plus or minus)

FLAT SHEET*

Standard Thickness† (inches)	Tolerance in Per Cent of Nominal Thickness or in Inches: Widths up to 36″	Widths over 36″ to 42″	Widths over 42″ to 48″	Widths over 48″ to 54″	Widths over 54″ to 60″
.010, .012§	.0015	....	....	...	...
.014§	.0015	....	....	...	...
.016, .018	.002	....	....	...	...
.020, .025	.002	.0025	....	...	...
.032	.002	.0025	.0025	...	...
.040	.0025	.003	.003	.004	.005
.051	.003	.004	.004	.005	.006
.064	.003	.004	.004	.005	.006
.081, .091	.003	.004	.004	.005	.006
.102, .125	.0045	.005	.005	.005	.007
.156, .188, .204, .249	4%	5%	5%	5%	6%

*These tolerances apply only to sizes shown in TABLE V.
† Intermediate thicknesses take the next higher tolerance.
§ 28 inches in maximum width to which these tolerances apply.

COILED SHEET

Standard Thickness† (inches)	Thickness Tolerance in Inches: Widths up to 18″	Widths over 18″ to 24″
.012, .014, .016	.0015	.0015
.018, .020, .025	.0015	.002
.032, .040	.002	.0025
.051, .064	.0025	.003
.072	.0035	.004
.081	.004	.004
.091	.0045	.005
.102	.005	.005

† Intermediate thicknesses take the next higher tolerance.

PLATE

Thickness (inches)	Tolerance in Per Cent of Nominal Thickness: Width up to 54″	Widths over 54″ to 72″	Widths over 72″ to 90″	Widths over 90″ to 120″
.250 to .374	5	6	7	8
.375 to .500	5	5	6	7
.501 to 1.000	4	4	5	6
1.001 to 3.000	3	3	4	5

TABLE II
Commercial Tolerances for Wire, Rod and Bar

ROLLED ROUND ROD

Diameter (inches)	Tolerance (inches): Plus	Minus
1.501 to 3.499	.008	.008
3.500 to 5.000	1/32	1/64
5.001 to 8.000	1/16	1/32

ROLLED BAR

Squares, Hexagons*: Distance Across Flats (inches)	Tolerance (inches) Plus or Minus	Rectangles: Width (inches)	Tolerance (inches) Plus or Minus
up to .500	.006	up to 1.500	1/64
.501 to .750	.008	1.501 to 4.000	1/32
.751 to 1.000	.012	4.001 to 6.000	3/64
1.001 to 2.000	.016	6.001 to 10.000	1/16
2.001 to 3.000	.020		

* Hexagons available in sizes greater than 1.5-inch; smaller sizes cold finished.

WIRE, ROD AND BAR
(cold finished)

Diameter or Distance Across Flats (inches)	Tolerance (inches) Plus or Minus: Rounds	Squares Hexagons Octagons	Rectangles
up to .0359	.0005	....	....
.036 to .064	.001	.0015	.0015
.065 to .500	.0015	.002	.002
.501 to 1.000	.002	.0025	.0025
1.001 to 1.500	.0025	.003	.003
1.501 to 3.000	....	....	.005

TABLE III
Commercial Tolerances of Flattened Wire and Flattened Slit Wire

	FLATTENED WIRE (round edges) Commercial Sizes —(inches)— Minimum	Maximum	Tolerance, (inches) Plus or Minus		FLATTENED AND SLIT WIRE (slit edges) Commercial Sizes —(inches)— Minimum	Maximum	Tolerance, (inches) Plus or Minus
Thickness	.010	.020	.001	Thickness	.010	.020	.001
	.021	.060	.0015		.021	.060	.0015
	.061	.187	.002		.061	.080	.002
Width	.030	.875	.007	Width	.125	.625	.0025
	.876	2.000	.010		.626	1.500	.004
					1.501	4.750	.006

TABLE IV
Commercial Tolerances of Round Tubing

DIAMETER TOLERANCE

Outside Diameter (inches)	Tolerance (inches), Plus or Minus: Mean Diameter*	Individual Measurement of Diameter (out-of-roundness) except soft (O), or thin wall tubes†
⅛ to ½	.003	.006
½ to 1	.004	.008
1 to 2	.005	.010
2 to 3	.006	.012
3 to 5	.008	.016
5 to 6	.010	.020
6 to 8	.015	.030
8 to 10	.020	.040
10 to 12	.025	.050

WALL THICKNESS TOLERANCE

Nominal Wall Thickness (T) (inches)	Tolerance (inches), Plus or Minus: Mean Wall Thickness§	Individual Measurements of Wall Thickness
.010 to .035	.002	10% T
.036 to .049	.003	10% T
.050 to .120	.004	10% T
.121 to .203	.005	10% T
.204 to .300	.008	10% T
.301 to .375	.012	10% T
.376 to .500	.032	10% T

*Mean diameter is the average of any two measurements of diameter taken at right angles to each other at any point along the length of the tube.
†Thin wall tubes, i.e., tubes having a wall thickness less than 2.5 per cent of the diameter or less than .02-inch, and tubes in the soft (O) temper shall be commercially round. The deviations of individual measurements from the nominal will vary with the alloy and the ratio of wall thickness to diameter.
§Mean wall thickness is the average of the two measurements taken at opposite ends of any diameter of the tube

Materials Work Sheet

STRAIGHTNESS TOLERANCE

O.D. (inches)	Tolerance
⅜ to 12	.1-inch in 10 ft. or one part in 1200 parts of length.

Note: Tubing in the soft temper or in diameters less than ⅜-inch is supplied commercially straight, substantially free of kinks and short bends.

TABLE V
Commercial Sheet Sizes 24S-O AND 24S-T

Thickness (inches)	Standard Width (inches)	Maximum Commercial Dimensions Width (inches)	Length (feet)
.010 to .014	28	28	14
.015 to .018	36	36	14
.019 to .024	36	42	16
.025 to .029	48	48	16
.030 to .037	48	48	18
.038 to .060	48	60	18
.061 to .249	48	60	24

TABLE VI
Maximum Commercial Sizes. Flat Sheet and Plate 24S-RT

Thickness (inches)	Rolling Limits—Maximum Width (inches) Lengths up to 12 ft.	Lengths over 12 ft. to 18 ft.
.019 to .021	24	..
.022 to .923	24	..
.024 to .029	30	..
.030 to .037	36	36
.038 to .047	36	36
.048 to .060	42	36
.061 to .076	48	42
.077 to .095	48	..
.096 to .135	48	..
.136 to .249	48	..
.250 to .500	48	..

TABLE VII
Standard Sizes of Wire, Rod and Bar
COILED RIVET WIRE (24S)

Diameters: .061, .092, .123, .141, .153, .184, .247 and .310.

STRAIGHTENED 24S-T WIRE IN 12-FOOT LENGTHS

Rounds, diameters: 1/16, 3/32, 1/8, 5/32, 3/16, 7/32, 1/4, 9/32, 5/16, 11/32.
Hexagons, across flats: 3/16, 1/4, 5/16.
Squares, across flats: 3/16, 1/4, 5/16.

COLD-FINISHED ROD AND BAR IN 12-FOOT LENGTHS (24S-T)

Diameter or Across Flats (inches)	Shape: Round	Hexagon	Square
3/8	x	x	x
13/32	x		
7/16	x	x	x
1/2	x	x	x
9/16	x	x	x
5/8	x	x	x
11/16	x	x	x
3/4	x	x	x
13/16	x	x	x
7/8	x	x	x
15/16	x	x	x
1	x	x	x
1 1/16	x	x	x
1 1/8	x	x	x
1 3/16	x	x	x
1 1/4	x	x	x
1 5/16	x	x	x
1 3/8	x	x	x
1 7/16	x	x	x
1 1/2	x	x	x

ROLLED ROD AND BAR IN 12-FOOT LENGTHS (24S-T)

Diameter or Across Flats (inches)	Shape: Round	Hexagon	Square
1 9/16	x	x	
1 5/8	x	x	x
1 11/16	x		
1 3/4	x	x	x
1 13/16	x		
1 7/8	x	x	x
1 15/16	x		
2	x	x	x
2 1/16	x		
2 1/8	x		
2 3/16	x		
2 1/4	x		
2 5/16	x		
2 3/8	x		
2 7/16	x		
2 1/2	x		
2 9/16	x		
2 5/8	x		
2 11/16	x		
2 3/4	x		
2 13/16	x		
2 7/8	x		
3	x		
3 1/8	x		
3 1/4	x		x°
3 3/8	x		
3 1/2	x°		x°
3 3/4	x°		x°
4	x°		x°
4 1/4	x°		
4 1/2	x°		
4 3/4	x°		
5	x°		
5 1/4	x°		
5 1/2	x°		

°Random straight lengths.

MATERIAL DESIGNATIONS

Aluminum Co. of America
No. 24S-T

AMS Spec. Nos.
4035 (*plate and sheet*)
4037 (*plate and sheet*)
4120 (*B, R, W and S*)
4152 (*B, R, W and S*)
4088 (*round tubing*)

U. S. Navy Spec. Nos.
47A10 (*plate and sheet*)
46A9 (*B, R, W and S*)
44T28 (*round tubing*)
44T31 (*streamline tubing*)
43R5 (*rivets and rivet wire*)
B40 (*aircraft bolts and nuts*)
43B11 (*INT, bolts, nuts, studs and tap rivets*)
43S4 (*machine screws and nuts*)
42S5 (*machine screws and nuts*)

U. S. Air Corps Spec. Nos.
10235-A (*round tubing*)
57-187-2B (*streamline tubing*)
25526-B (*rivets*)
11329 (*rivet wire*)
29-59-B (*aircraft bolts*)
29-26-B (*aircraft nuts*)

SAE Spec. No.
24

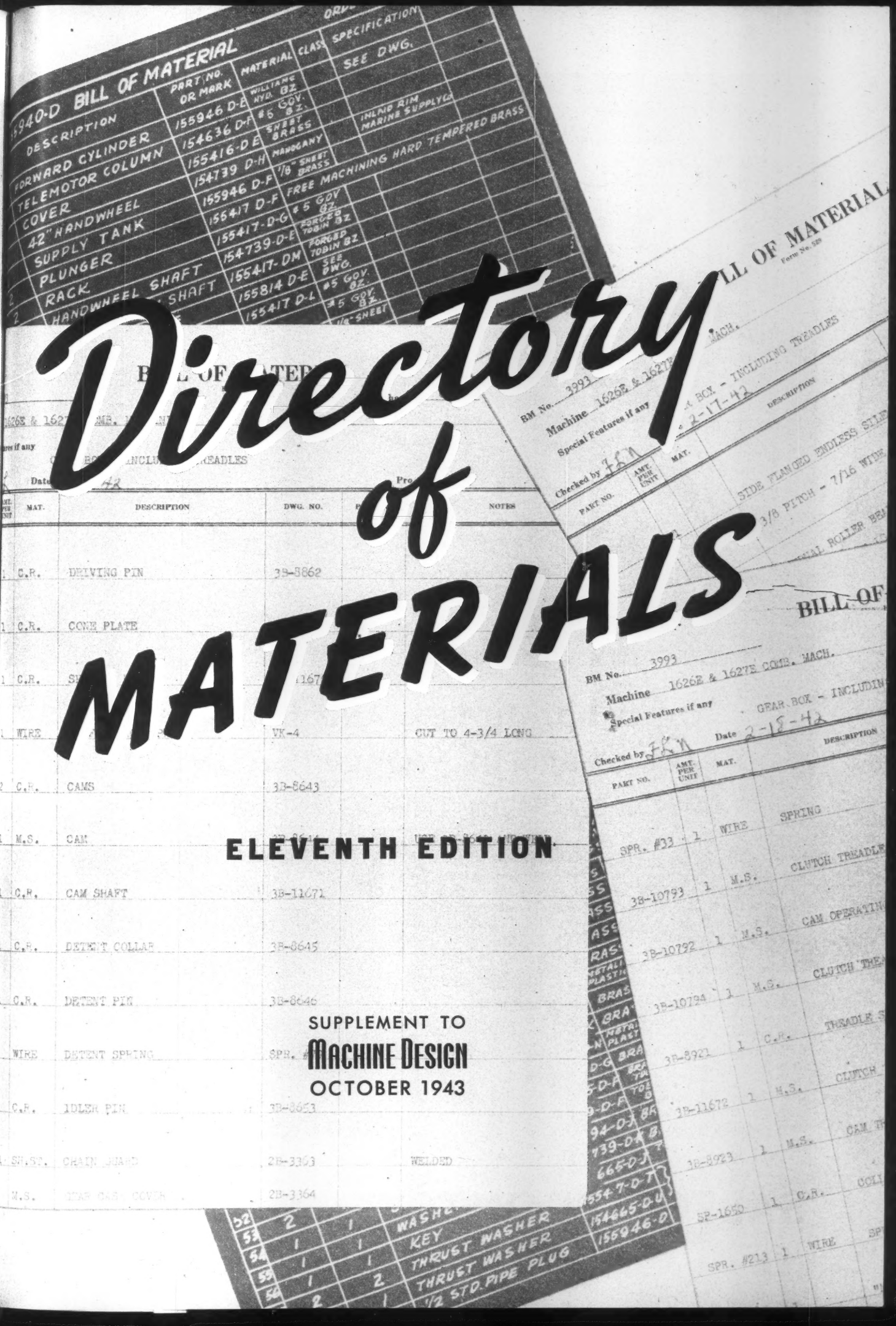
Federal Spec. Nos.
QQ-A-355 (*plate and sheet*)
QQ-A-354 (*B, R, W and S*)
FF-B-571 (*bolts, nuts, studs and tap rivets*)
FF-S-91 (*machine screws and nuts*)

Note: Because of frequent changes, the letter which indicates the current revision is not included.

TABLE VIII
Standard Sizes of Wire, Rod and Bar
24S-T SQUARE-EDGE RECTANGULAR BAR—STANDARD 12-FOOT LENGTHS, COLD FINISHED (CF), ROLLED (R)

Width (inches)	Thickness (inches) 1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3
3/8	CF	CF	CF	CF	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7/16	...	CF	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1/2	CF	CF	CF	CF	CF	CF	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9/16	CF	CF	CF	CF	CF	CF	CF	CF	*	...	...	...	...	...	...	...	...	...	...	...	...	...
5/8	CF	CF	CF	CF	CF	CF	CF	CF	CF	*	...	...	...	...	...	...	...	...	...	...	...	...
11/16	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	*	...	...	...	...	...	...	...	...	...	...	...
3/4	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	*	...	...	...	...	...	...	...	...	...	...
13/16	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	*	...	...	...	...	...	...	...	...	...
7/8	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	*	...	...	...	...	...	...	...	...
15/16	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	*	...	...	...	...	...	...	...
1	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	*	...	...	...	...	...	...
1 1/4	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	*	...	...	...	...	...
1 1/2	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	*	...	...	...	...
1 3/4	...	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	*	...	...	...
2	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	R	...	...	...
2 1/4	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	R	R	...	...
2 1/2	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	R	R	R	...	...
2 3/4	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	R	R	R	...	...
3	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	R	R	R	R	R	R	R	R	...	...
3 1/2	...	...	R	CF	R	...	R	...	R	R	R	R	R	R	R	R	R	R	R	R	...	...
4	...	...	R	R	R	...	R	...	R	R	R	R	R	R	R	R	R	R	R	R	R	R
4 1/2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R	R	R	...	...
5	...	...	R	...	R	...	...	...	...	...	...	...	...	...	...	R	R	R	R	R	R	R
6	...	...	R	R	R	...	R	...	R	R	R	R	...	R	R	R	R	R	R	R	R	R
8	...	...	...	...	...	...	R	...	...	R	...	R	...	R	...	R	R	R	...	...	...	...
10	...	...	...	R	R	...	R	...	R	R	R	R	R	R	R	R	R	R	...	...	...	...

*Square is also available.


BILL OF MATERIAL
DESCRIPTION
PART NO. OR MARK
MATERIAL
CLASS
SPECIFICATION
FORWARD CYLINDER
TELEMOTOR COLUMN
COVER
42" HANDWHEEL
SUPPLY TANK
PLUNGER
RACK
HANDWHEEL SHAFT
SEE DWG.
MAHOGANY
FREE MACHINING HARD TEMPERED BRASS
Directory of MATERIALS
ELEVENTH EDITION
SUPPLEMENT TO
MACHINE DESIGN
OCTOBER 1943

Design Roundup

Improved Treatment for Shell

Great many varied reports have been circulating relative to the success—or lack of success—of steel cartridge cases designed to relieve the shortage in brass. One of the principal difficulties has been attributed to the protective coatings on the surface of the cases which caused them to stick in the gun barrels upon continued rapid firing.

This objective now is being overcome by electroplating the steel cases with zinc followed by a chromating treatment which involves immersing them in a solution containing 200 grams of sodium dichromate and 6 to 9 cubic centimeters of concentrated sulphuric acid per liter of water. The same process is well adapted to treatment of zinc die-cast and zinc-coated machine parts which normally develop a white oxide film when subjected to entrapped moisture.

Electronics Strides Ahead

Applications of electrons hold unlimited possibilities and are expected to influence profoundly the design of machines in the postwar period. This trend, well under way for several years, received a setback with the war as restrictions were imposed upon the manufacture of many types of industrial machinery.

Meanwhile, basic research has continued unabated. At the same time, applications of electronics to equipment required for the waging of war—for example, radio and radar—have introduced new conceptions of the worth and utility of the science. Thousands of young Americans will emerge from their military service with a familiarity of electronics that will go along with them into peacetime pursuits in industry. This favorable circumstance is not to be overlooked in future electronic progress.

Industrial applications, such as welding-machine controls, induction heating, speed controls, power conversions, and the like, are well known. Their first utilizations effected basic changes in equipment design, and their further adaptations in years to come will produce similar results.

Variable-speed control for drives with alternating-current motors, through a source of variable-frequency power, should be extremely useful in operation of high-speed machines. Likewise, the recent application of high-frequency, high-power oscillators and mercury-vapor rectifiers with photoelectric regulators to control the flow of tin on tin plate has wide potentialities. Among other devices about to make their appearance is an electronic method for demagnetizing magnetic chucks to facilitate removal of work from the chucks.

Selecting Steel Economically

One of the most important assets to material specification practice being developed at an accelerated rate as a result of the war is now one of industry's biggest headaches. Brought on by the necessity for substitution in critical alloys, the search for steels which will meet stiff physical requirements without critical components has resulted in a new technique which probably will persist after the war.

Supplanting, or rather augmenting, the simple-to-handle "loaded" alloys will be the less costly but more temperamental low alloy and carbon steels. Specifications will be inclined toward the physical requirements rather than the chemical composition, and the heat-treating facilities of the customer will be taken into consideration. For example, an actuating cam in a packaging machine will be made from steel which will provide the necessary hardenability and ductility at the lowest cost to the fabricator. If that fabricator has good heat-treating facilities and a flexible practice, he can use a lower cost steel and achieve the necessary results. The odd shape of that part has made it difficult in the past to obtain the hardenability required.

Much work has been done since the start of the war—and much more will be done in the months to come—by metallurgists and designers in cooperation, toward the establishment of exact methods for determining these unknowns. Much has also been done and will be done on heat-treating techniques to spread the usability of common steels. A good example of this is the Nelson process, invented by a Californian and reported at the recent meeting of the American Chemical Society, by means of which ordinary 1020 carbon steel gives tensile strength up to 130,000 pounds per square inch and ultimate strength up to 190,000. The steel is quenched at 1700 degrees Fahr. in a solution of 35 per cent sodium or potassium hydroxide at room temperature.

MACHINE DESIGN'S

Materials Work Sheet

Filing Number 9.00

ALUMINUM ALLOY 24S-T

AVAILABLE IN: Sheet, plate, wire, rod and bar, extruded shapes, tubing and pipe, rivets

ANALYSIS: .5 copper; .6 manganese; 1.5 magnesium; remainder aluminum plus normal impurities

PHYSICAL PROPERTIES

TENSILE STRENGTH
(minimum—psi)

Bars	62,000
Flat sheet and plate .012 to .249-inch thk.	64,000
.250 to 1.000	62,000
1.001 to 2.000	60,000
Tubing	64,000

YIELD STRENGTH IN TENSION
(minimum—psi)

Bars	40,000
Flat sheet and plate .012 to .249-inch thk.	42,000
.250 to 2.000	40,000
Tubing	42,000

ELONGATION IN 2 INCHES
(minimum)

Bars (rolled rd., sq., hex., oct. and rectangle)	14
Flat sheet and plate .012 to .020-inch thk.	10
.021 to .051	13
.052 to .128	15
.129 to .249	14
.250 to .500	12
.501 to 1.000	8
1.001 to 1.500	7
1.501 to 2.000	6
Tubing 1¼ to 2 inches diameter:	
.025 to .049 wall thk.	12
.050 to .259	14
.260 to .500	16
Tubing 2 to 8 inches diameter:	
.025 to .049 wall thk.	10
.050 to .250	11
.260 to .500	12

BRINELL HARDNESS
(500 kg. load, 10mm. ball—minimum)

All forms	105

MELTING POINT
(liquidus—deg. F.)

All forms	1,180

TEMPERATURE COEF. OF RESISTANCE
(ohms per ohm per deg. C.)

0 to 100 deg. C.	.0020

SPECIFIC GRAVITY

All forms	2.77

SHEARING STRENGTH
(typical—psi)

All forms	41,000

FATIGUE ENDURANCE LIMIT
(typical—psi)

All forms	18,000

MODULUS OF ELASTICITY
(psi)

All forms	10,500,000

TORSIONAL MODULUS OF ELASTICITY
(psi)

All forms	3,950,000

WEIGHT
(lb. per cu. in.)

All forms	.100

COEF. OF THERMAL EXPANSION
(per deg. F.)

68 to 212 deg.	.0000122
68 to 392 deg.	.0000130
68 to 572 deg.	.0000138

THERMAL CONDUCTIVITY
(at 100 deg. C.—C. G. S. units)

All forms	.28

ELECTRICAL CONDUCTIVITY
(% of copper std.)

All forms	30

ELECTRICAL RESISTIVITY
(microhms per cm.³)

At 20 deg. C.	5.75

PHYSICAL PROPERTIES AT ELEVATED TEMPERATURES

	Temperature in deg. F.					
	75	300	400	500	600	700
TENSILE STRENGTH *(typical—psi)*	68,000	42,000	28,000	14,000	7,500	5,000
YIELD STRENGTH *(typical—psi)*	45,000	35,000	21,000	9,000	5,000	3,500
ELONGATION IN 2 INCHES *(per cent)* Round specimen ½ inch diameter	22	21	25	40	65	100

MACHINE DESIGN is pleased to acknowledge the collaboration of Aluminum Company of America in this presentation.

Materials Work Sheet

BEND RADII FOR FLATS, SHEETS AND STRIPS

Minimum recommended radii for 90-deg. bend in terms of thickness (t) expressed in inches:

Thickness (t)	1/64	1/32	1/16	1/8	3/16	1/4
Radii	1½t to 3t	2t to 4t	3t to 5t	4t to 6t	4t to 6t	5 to 7t

Note: If bending is done in the annealed state or immediately after quenching, this material can be formed over appreciably smaller radii.

SAFE INTERNAL WORKING PRESSURES OF TUBING

Apply formula:

$$P = S - \frac{D^2 - d^2}{D^2 + d^2}$$

in which P = internal working pressure (psi)
S = working stress (psi)
D = O. D. of tube (inches)
d = I. D. of tube (inches)

The working stress of this material (24S-T) at room temperature may be taken as 17,000 psi, based on a safety factor of 4.

To determine the internal working pressures at elevated temperatures, multiply the working stress at room temperature (17,000) by the following factors:

	Temperature Deg. F.				
	75	200	300	400	500
Conversion Factors	1.00	.88	.61	.32	.14

APPLICATION

For parts and structures requiring most favorable strength-weight ratio. Is standard alloy for aircraft sheet, structural tubing, thin extrusions and rolled bar. Must be protected from contact with heavy metals such as copper, tin, brass, bronze and lead to prevent galvanic corrosion under severe conditions such as sea water and marine atmospheres.

CHARACTERISTICS

This alloy is of the same type as the older 17S-T. Its mechanical properties are higher as a result of an increase in the percentage of alloying constituents. It is somewhat more difficult to work than 17S-T in corresponding tempers. When properly heat treated its resistance to corrosion is good, as evidenced by its service history in aircraft including the floats and hulls of seaplanes. In addition to its high strength, it has all the normal characteristics of other aluminum alloys.

FABRICATION

MACHINABILITY:

Good; takes a smooth finish.

STAMPING, FORMING AND DRAWING:

Stamps readily and can be formed not too severely in the heat-treated state (*see Recommended Bend Radii*). Severe forming can be done only with the material in its annealed state or immediately after quenching from the heat-treating temperature. For general spinning and drawing, the softer, more ductile grades such as 2S or 3S will be found easier to work and should be used if their strength is adequate.

FORGING:

Not made for forging.

WELDING, BRAZING AND SOLDERING:

No satisfactory technique has yet been developed.

RESISTANCE TO CORROSION

Although this alloy does not corrode appreciably in dry, clean inland atmospheres, it is customary to protect it with paint coatings usually preceded by anodizing or chemical-dip oxide coating. In marine and highly contaminated industrial atmospheres, joint coatings preceded by anodic or other types of oxide treatments are recommended. Not as corrosion resistant as aluminum alloy 2S (commercially pure aluminum) or the silicon and manganese-bearing aluminum alloys.

CORROSION-RESISTANT FINISHES

Anodic coatings, which can be applied in various colors (by die or pigment adsorption) provide good resistance to corrosion, have high dielectric strength and can be made hard so as to offer resistance to abrasion and durability to the part. For maximum resistance to corrosion, anodic coatings should be sealed with a chromate or other sealer. Electroplated chromium finishes are sometimes applied where corrosion and abrasion resistance is required.

GALVANIC CORROSION

Contact of this alloy with copper, nickel, brass, bronze, monel, iron and steel should be avoided in the presence of salt water or sea coast atmospheres, as these metals are cathodic to 24S-T and the resulting galvanic couple results in accelerated corrosion. Zinc and cadmium-plated parts, however, can safely be used in contact with it.

HEAT TREATMENTS
(for 24S to produce 24S-T)

Either a fused salt bath or an air-chamber furnace of proper design may be used. If salt bath is used, salt must be thoroughly rinsed from the parts after treatment. Temperature for the soaking periods below are for the parts being treated, not the furnace.

Thickness (inches)	Time	Temperature
up to 1/32	30 min.	910 deg. F.
over 1/32 to 1/8	30 min.	to
over 1/8 to 1/4	40 min.	
over 1/4	60 min.	930 deg. F.

After soaking at temperature indicated, a rapid quench in water kept below 90 deg.F. is essential to produce maximum corrosion resistance. Use ample volume of water and space parts generously during soaking and quenching.

DATA ON STOCK FORMS

TABLE I
Commercial Thickness Tolerances
(plus or minus)

FLAT SHEET*

Standard Thickness† (inches)	Tolerance in Per Cent of Nominal Thickness or in Inches: Widths up to 36"	Widths over 36" to 42"	Widths over 42" to 48"	Widths over 48" to 54"	Widths over 54" to 60"
.010, .012§	.0015	....	....	...	...
.014§	.0015	....	....	...	...
.016, .018	.002	....	....	...	...
.020, .025	.002	.0025	....	...	...
.032	.002	.0025	.0025	...	...
.040	.0025	.003	.003	.004	.005
.051	.003	.004	.004	.005	.006
.064	.003	.004	.004	.005	.006
.081, .091	.003	.004	.004	.005	.006
.102, .125	.0045	.005	.005	.005	.007
.156, .188 .204, .249	4%	5%	5%	5%	6%

*These tolerances apply only to sizes shown in TABLE V.
† Intermediate thicknesses take the next higher tolerance.
§ 28 inches in maximum width to which these tolerances apply.

COILED SHEET

Standard Thickness† (inches)	Thickness Tolerance in Inches: Widths up to 18"	Widths over 18" to 24"
.012, .014, .016	.0015	.0015
.018, .020, .025	.0015	.002
.032, .040	.002	.0025
.051, .064	.0025	.003
.072	.0035	.004
.081	.004	.004
.091	.0045	.005
.102	.005	.005

† Intermediate thicknesses take the next higher tolerance.

PLATE

Thickness (inches)	Tolerance in Per Cent of Nominal Thickness: Width up to 54"	Widths over 54" to 72"	Widths over 72" to 90"	Widths over 90" to 120"
.250 to .374	5	6	7	8
.375 to .500	5	5	6	7
.501 to 1.000	4	4	5	6
1.001 to 3.000	3	3	4	5

TABLE II
Commercial Tolerances for Wire, Rod and Bar

ROLLED ROUND ROD

Diameter (inches)	Tolerance (inches): Plus	Minus
1.501 to 3.499	.008	.008
3.500 to 5.000	1/32	1/64
5.001 to 8.000	1/16	1/32

ROLLED BAR

Squares, Hexagons*: Distance Across Flats (inches)	Tolerance (inches) Plus or Minus	Rectangles: Width (inches)	Tolerance (inches) Plus or Minus
up to .500	.006	up to 1.500	1/64
.501 to .750	.008	1.501 to 4.000	1/32
.751 to 1.000	.012	4.001 to 6.000	3/64
1.001 to 2.000	.016	6.001 to 10.000	1/16
2.001 to 3.000	.020		

* Hexagons available in sizes greater than 1.5-inch; smaller sizes cold finished.

WIRE, ROD AND BAR
(cold finished)

Diameter or Distance Across Flats (inches)	Tolerance (inches) Plus or Minus: Rounds	Squares Hexagons Octagons	Rectangles
up to .0359	.0005	....	....
.036 to .064	.001	.0015	.0015
.065 to .500	.0015	.002	.002
.501 to 1.000	.002	.0025	.0025
1.001 to 1.500	.0025	.003	.003
1.501 to 3.000	....	....	.005

TABLE III
Commercial Tolerances of Flattened Wire and Flattened Slit Wire

	FLATTENED WIRE (round edges) Commercial Sizes (inches) Minimum	Maximum	Tolerance, (inches) Plus or Minus		FLATTENED AND SLIT WIRE (slit edges) Commercial Sizes (inches) Minimum	Maximum	Tolerance, (inches) Plus or Minus
Thickness	.010	.020	.001	Thickness	.010	.020	.001
	.021	.060	.0015		.021	.060	.0015
	.061	.187	.002		.061	.080	.002
Width	.030	.875	.007	Width	.125	.625	.0025
	.876	2.000	.010		.626	1.500	.004
					1.501	4.750	.006

TABLE IV
Commercial Tolerances of Round Tubing

DIAMETER TOLERANCE

Outside Diameter (inches)	Tolerance (inches), Plus or Minus: Mean Diameter*	Individual Measurement of Diameter (out-of-roundness) except soft (O), or thin wall tubes†
1/8 to 1/2	.003	.006
1/2 to 1	.004	.008
1 to 2	.005	.010
2 to 3	.006	.012
3 to 5	.008	.016
5 to 6	.010	.020
6 to 8	.015	.030
8 to 10	.020	.040
10 to 12	.025	.050

WALL THICKNESS TOLERANCE

Nominal Wall Thickness (T) (inches)	Tolerance (inches), Plus or Minus: Mean Wall Thickness§	Individual Measurements of Wall Thickness
.010 to .035	.002	10% T
.036 to .049	.003	10% T
.050 to .120	.004	10% T
.121 to .203	.005	10% T
.204 to .300	.008	10% T
.301 to .375	.012	10% T
.376 to .500	.032	10% T

*Mean diameter is the average of any two measurements of diameter taken at right angles to each other at any point along the length of the tube.

†Thin wall tubes, i.e., tubes having a wall thickness less than 2.5 per cent of the diameter or less than .02-inch, and tubes in the soft (O) temper shall be commercially round. The deviations of individual measurements from the nominal will vary with the alloy and the ratio of wall thickness to diameter.

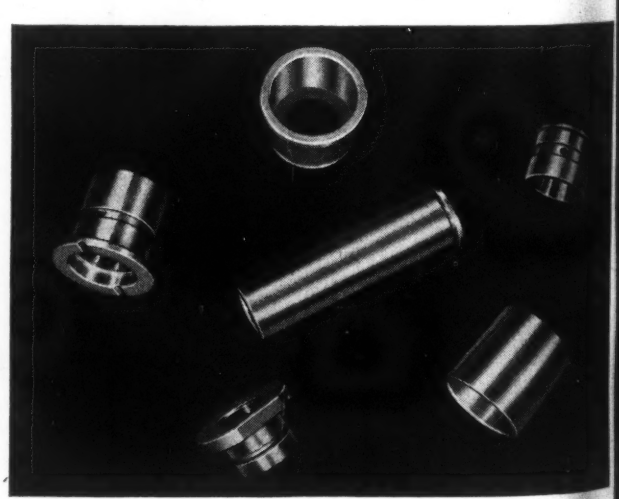
§Mean wall thickness is the average of the two measurements taken at opposite ends of any diameter of the tube

ON LAND, ON SEA, AND IN THE AIR— ALL OVER THE WORLD SABECO BRONZE IS ON THE JOB

In Allied War planes over Germany and Japan; in motorized equipment and fighting ships on the continent, Africa, New Guinea and Australia—in America from coast to coast—all over the world Sabeco Bronze bearings and seals are playing an important part in the efficient operation of motors and pumps and machines.

Sabeco Bearing Bronze is perfected from a formula of copper, tin and lead, with the tin and lead evenly distributed throughout. It has no hard spots, contains less than 2/10 of 1% impurities. It outwears all other bronzes, and will not burn, pound out, score or seize a shaft. Because of its unusual properties, Sabeco operates satisfactorily with water as its only lubricant.

Our engineering staff is at your service to help you determine if and how Sabeco Bronze parts can improve the efficiency of your products.



NO. 5 SABECO IS COMPARABLE TO AMS 4840

SABECO BRONZE SAGINAW BEARING CO., SAGINAW, MICH.

ON LAND, ON SEA, AND IN THE AIR— ALL OVER THE WORLD SABECO BRONZE IS ON THE JOB

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SABECO BRONZE SAGINAW BEARING CO., SAGINAW, MICH.

This is a chunk of Bornite—*weight 1¼ lb.*

Pretty, isn't it? But it takes a surprising lot of this "rock" and other copper ores to supply today's demands. A chunk of bornite this size is needed for the *single ounce* of copper in the cup for ONE caliber .50 tracer bullet jacket.

Nature doesn't give up its copper easily. It takes time to mine, crush and grind the ore, to smelt it . . . to refine the copper, melt and cast it. Only then is copper ready to be remelted and alloyed, cast, rolled or drawn into commercial shapes such as sheets, wire, rods and tubes—in quantities never before imagined possible—yet scarcely enough to go 'round. So we ask that you conserve it. Use it wisely.

Where is all the copper going? Everywhere. 950 lb. in an M-4 tank, 348,000 lb. in a submarine, 463,000 lb. in a destroyer. And in the air, a place you'd least expect it, a Flying Fortress takes 2,968 lb., a Curtiss P-40, 1,001 lb. The Bell Airacobra, illustrated above in action, used 938 lb. of copper in its construction. And as for ammunition—a single plane such as this, shooting continuously instead of in bursts, could "use up" an additional 280 lb. of copper in sixty seconds of combat.

Turn the page and see the job that Anaconda Copper and its alloys Brass and Bronze are doing in the Aircraft Industry.

ANACONDA from m[illegible]sumer
REG. U.S. PAT. OFF.

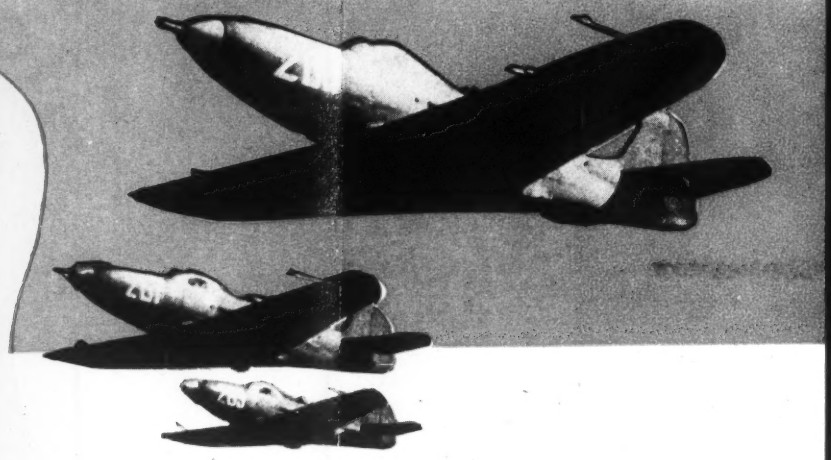
THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Anaconda Copper & Copper Alloys

FITTING THE METAL TO THE NEED

means more flying hours—less work for the ground crew

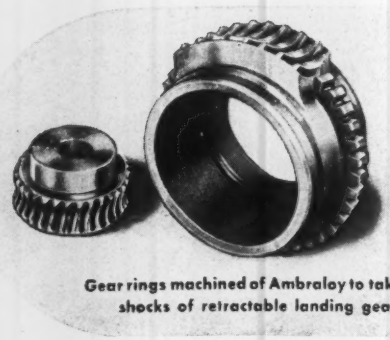


Anaconda Copper Alloys are not newcomers to the Aviation Industry. They played an important part in the engines that made possible the first trans-Atlantic, trans-Pacific and round-the-world flights.

But times and planes have changed, and with them designs for engines, structural equipment and accessories. New standards of aircraft engineering lean heavily on specially developed copper alloys for hundreds of special-purpose applications. Some of these Copper Alloys are briefly described here—each performs its assigned task efficiently and dependably, reducing maintenance and saving priceless man- and plane-hours.

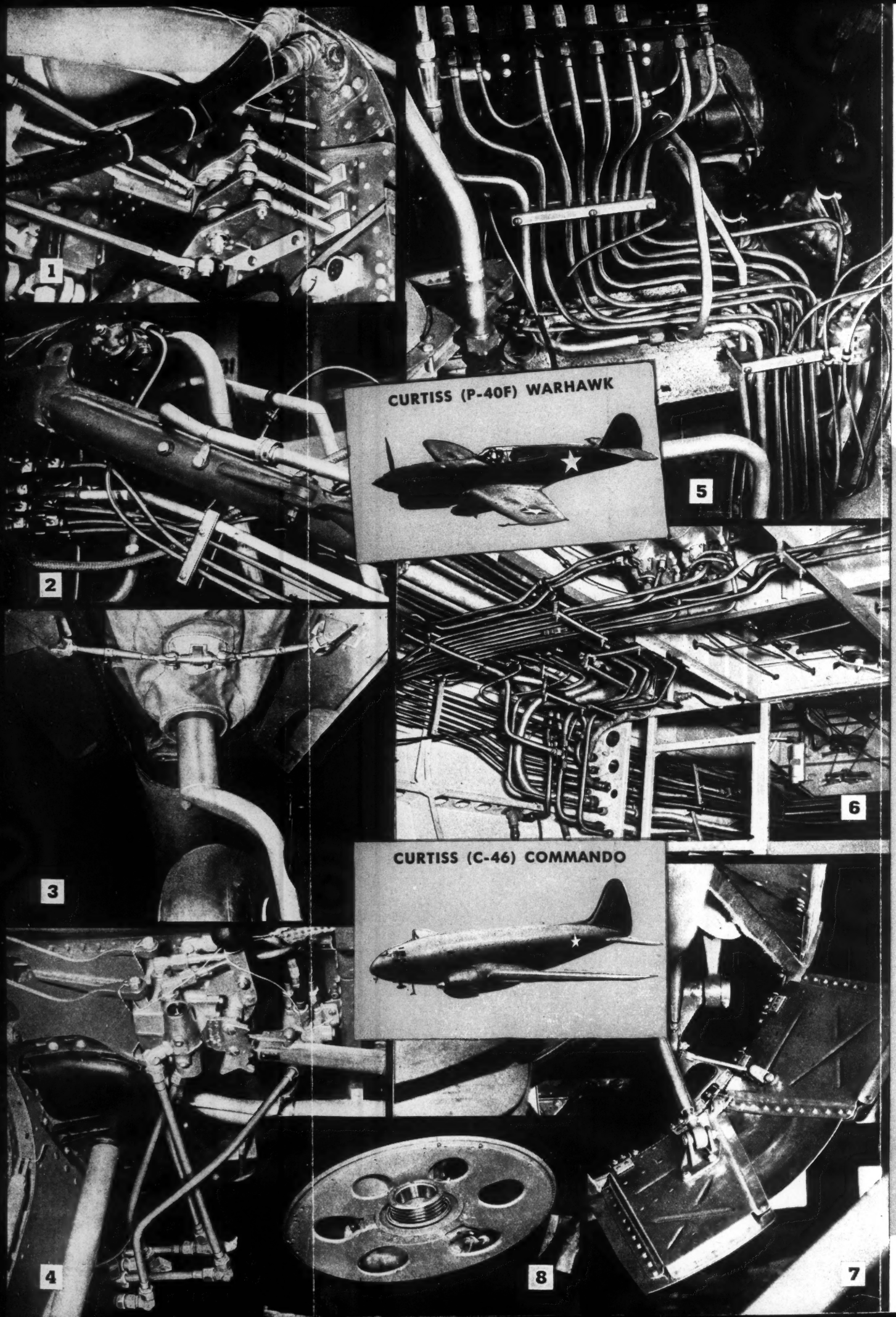
Avialite intake valve seat insert for Pratt & Whitney Aircraft Engines.

AVIALITE 915. This special aluminum bronze was developed by The American Brass Company for valve seats and guides to withstand the hammering or peening of valves on long, high speed flights. It is also remarkably resistant to pitting by carbon. The coefficient of expansion of Avialite 915 closely corresponds to that of aluminum alloy piston heads, making it an exceptionally suitable material for spark plug bushings. Avialite 915 has been applied to many other aircraft uses including propeller hub cones, gears, bushings and machined parts. One of the foremost builders of aircraft engines uses *85 different parts* made of this Anaconda Alloy.



Gear rings machined of Ambraloy to take shocks of retractable landing gear.

OTHER ALUMINUM BRONZES. Ambraloy 928 and 917 are other aluminum bronzes extensively used for the construction of aircraft and, together with Avialite 915, are the most important copper base alloys used in the aircraft industry. While each has its special application, their outstanding characteristics are: *(1)* Good corrosion resistance, *(2)* high strength, *(3)* resistance to oxidation at elevated temperatures, *(4)* good bearing qualities under certain conditions, *(5)* lighter weight . . . 5% to 10% less than ordinary brasses and bronzes.


1
2
3
4
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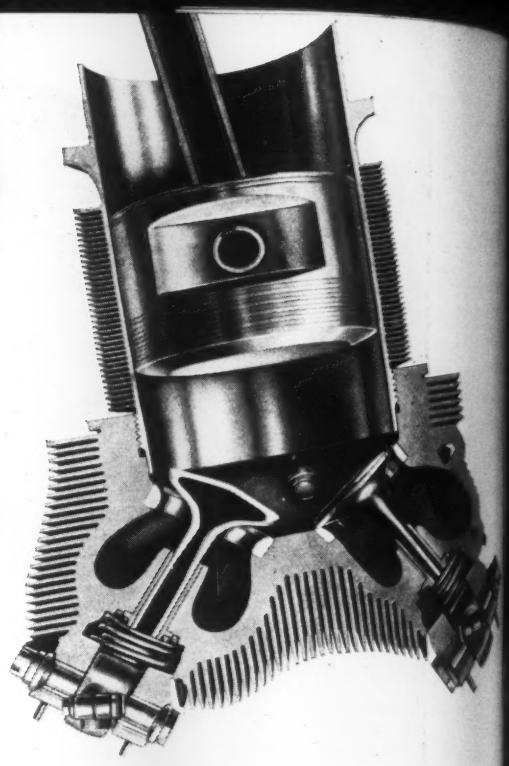
8
CURTISS (P-40F) WARHAWK
CURTISS (C-46) COMMANDO

SO MANY PLACES for such a versatile group of Copper Alloys



For maximum performance, Copper Alloys often combine in one material the desirable properties of several metals. Illustrated here are a number of uses of Anaconda Copper Alloys in the Aircraft Industry. Some alloys were chosen for their high tensile strength combined with a high fatigue limit; others for their good spring qualities, hardness and high conductivity; yet others provide good bearing qualities with excellent corrosion resistance. Strong, tough, workable, weldable and machinable, Anaconda Copper Alloys are readily adaptable to the high standards of aviation engineering.

1. In a pursuit ship such as Curtiss-Wright Corporation's P-40, engine controls are doubly important. Tobin Bronze tubing such as pictured provides the necessary strength and resistance to vibration.

2. Flexible Anaconda Copper Tubes convey the gasoline and lubricating oil for the Packard Rolls-Royce P-40 Engine, and filtered air for instrument operation.

3. Corrosion resistant Tobin Bronze turnbuckle barrels operate the doors covering the retractable P-40 tail wheel.

4. Controls in the P-40 cockpit operate landing gear and flaps through hydraulic lines of high strength Everdur tubing.

5. Interesting and intricate is this instrument panel piping arrangement on a Curtiss C-46 Commando. Most of the tubing is Everdur, used for hydraulic lines and automatic pilot controls.

6. Not an oil refinery—just a small portion of the hydraulic tubing necessary for the efficient operation of a C-46. Majority of the lines are made of dependable Everdur.

7. These little hinges on the cowl flap of the P-40 take a beating from vibration—that's why they're made of Avialite. Tobin Bronze is used for the torque tube cowl adjustments.

8. This mysterious-looking mechanism is part of a Curtiss electrically operated variable pitch propeller. Following tests made on numerous metals, Everdur was selected for the contact rings because of its strength and high resistance to fatigue and corrosion.

9. Rugged metals for fighting ships. Many inconspicuous but highly necessary small parts such as these adapter terminals, and trunnions which are machined from Anaconda Rod and Tube, go into the Bell Aircraft Corporation's famed Airacobra and its equally famous power plant, the Allison Engine.

10. O. K.'d and ready for installation, these Airacobra oil coolers have shells of brass and tubes of copper—the favorite metals for heat transfer equipment.

11. The pilot's oxygen equipment in the nose of the Airacobra comes under the heading of "must be dependable"—hence the use of *Seamless* Flexible Metal Tubing made for many aircraft uses by the American Metal Hose Branch of The American Brass Company.

12. Cylinder assembly of the Jacobs L-4 MBB engine built by the Jacobs Aircraft Engine Co., and used to power the AT-17 "Bobcat" and the C-78 light Personal Transport. Sparkplug bushings are made of Avialite and intake port screw inserts of Everdur Metal.

13. Trim and highly efficient, these fighting Airacobras roll off Bell Aircraft Corporation's assembly lines in an endless procession.

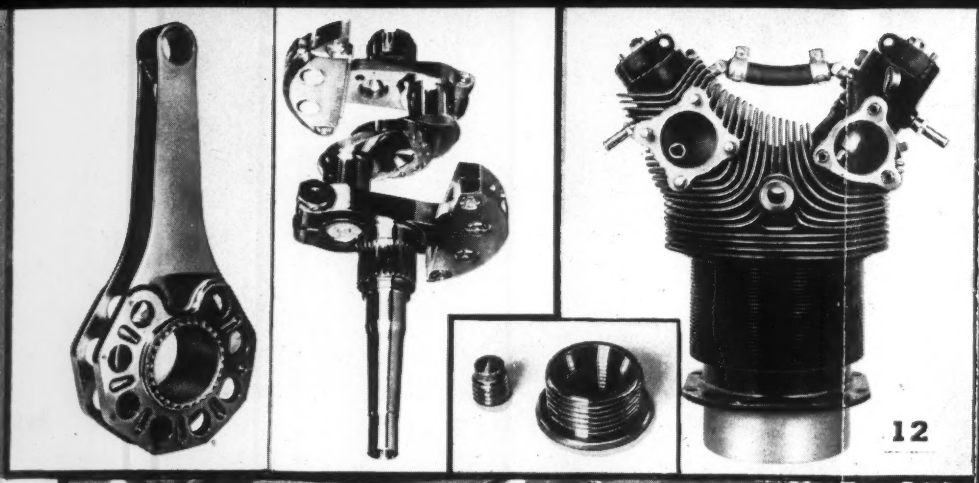
14. Turnbuckles play an important part in every type aircraft. They are extensively used in engine controls, wing flaps, landing gear, and for internal strengthening of the fuselage and wings. Pictured here in the wing flaps of the Airacobra, the turnbuckle barrels are made of high strength Tobin Bronze.

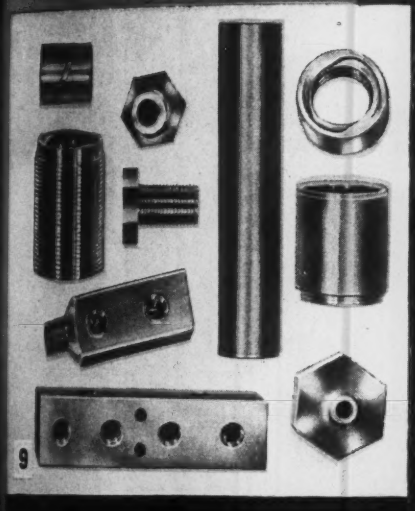
ANACONDA
from mine to consumer
REG. U.S. PAT. OFF.

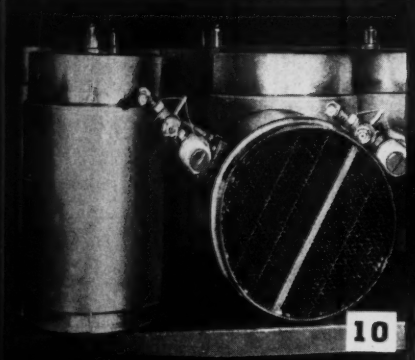
Anaconda Copper & Copper Alloys

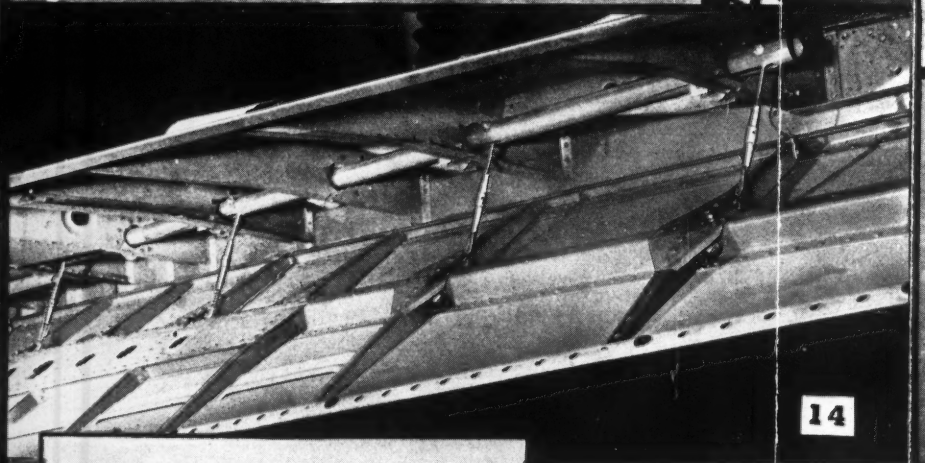
...ER: Cylinder of a Wright Cyclone ...gine, built by the Wright Aeronauti... ...al Corporation. Valve guides, rocker ...m bushings and spark plug inserts ...re made of special Anaconda Alloys.

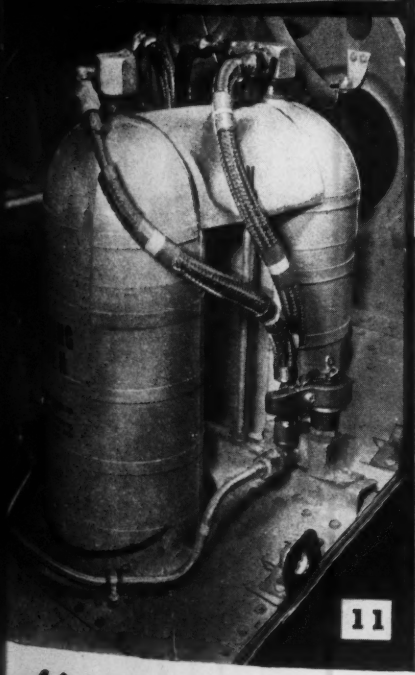
...ROD: The master connecting rod of ...this engine is bushed with bronze and ...special lead-bearing copper alloys. On ...the crankshaft of the Cyclone, bronze ...plates reduce friction between the ...crankcheek and rapidly oscillating ...damper.

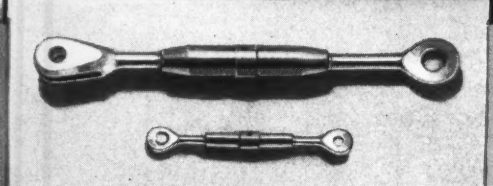












Tons of specially-treated Tobin Bronze are used by the Aero Supply & Manufacturing Company in producing the barrels of aeronautical turnbuckles. As a result of recent cooperation between the engineering departments of the Aero Supply & Manufacturing, and The American Brass Company, tubing of extremely heavy wall was developed to replace the rod stock previously used.

RESULT: A 33% saving both in material and machine time, and an improvement in deliveries of 30 to 60 days.

The
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...s *Made by The American Brass Company*

THIS partial list is indicative of the parts, places, equipment and accessories in which Anaconda Metals are used in the Aircraft Industry. Forms include sheet, wire, rod, tubes, special drawn shapes, hot pressed parts and pressure die castings.

●

Spark plugs
Bellows
Radio parts
Condensers
Terminals
Thermostats
Oxygen masks
Battery parts
Electrical instruments
Gunsight parts
Strainers
Meters
Gages
Wire cloth
Tie wire
Water stills
Carburetor parts
Transmitter equipment
Springs
Rivets
Indicators
Generators
Starters
Gears
Hydraulic assemblies
Regulators
Gyroscopes
Drift meters
Lens mounts
Bushings
Bearings
Pump parts
Magnetos
Valve stems
Valve guides
Bolts, nuts, screws
Other fastenings

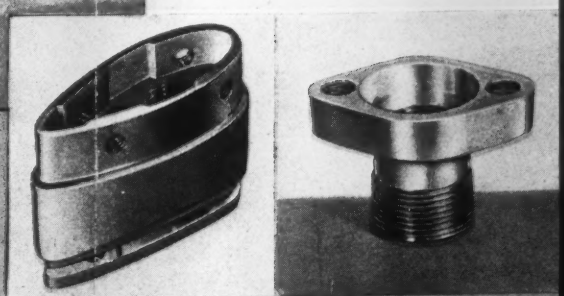
The foregoing pages illustrate some specific applications of Anaconda Copper, Brass and Bronze as used in the Aircraft Industry. To make the list complete would require a great many more pages. Parts similar to those illustrated—and many others—are incorporated in the construction of the aircraft shown directly above.

Just completed and ready to go, Consolidated Vultee Aircraft Corporation's Liberator Express Transports outside the assembly building.

Double assembly lines in a plant of the Consolidated Vultee Aircraft Corporation. In the foreground are B-24 Liberator Bombers being fitted with "fighting extras." 3025 lb. of copper—in all forms—go into a plane like this. In the background is an assembly line for C-87 Liberator Express Transports, produced exclusively by Consolidated.

North American Aviation's B-25 Mitchell Bomber. It takes 2010 lb. of copper in the form of copper, brass, bronze and special copper alloys to build this plane.

North American Aviation's Fighter, the P-51 Mustang. 681 lb. of copper in all forms are used in building this trim fighting machine.



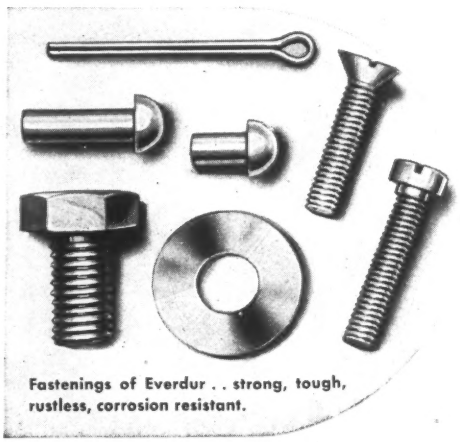
LEFT: Airspeed Tube component as manufactured by the Dominion Electrical Mfg., Inc. This unique shaped part is an Anaconda Pressure Die Casting.

RIGHT: Tachometer Coupling as used by Pratt & Whitney Aircraft to connect the tachometer drive shaft. Subject to unusual vibration, the metal selected for it was Anaconda Avialite.

TOBIN BRONZE: Tobin Bronze was one of the first scientifically developed copper base engineering alloys. This copper-zinc-tin alloy was originated in 1885 by Lt. Tobin, a naval officer seeking an alloy to resist salt water corrosion. Since then, the fabricating technique of The American Brass Company has improved Tobin Bronze so that today it is outstanding as an engineering material. Tobin Bronze is used for airplane turnbuckle barrels (see inside pages), lock nuts, valve stems and many other motor and equipment parts. In the form of wire and rod, Tobin Bronze is widely used for high-strength assembly of iron, steel and copper alloy parts by low-temperature oxy-acetylene welding.

Heavy wall Tobin Bronze tube for aeronautical turnbuckles.

EVERDUR: Everdur Metal, the original Copper-Silicon alloy, was developed for engineering uses requiring the tensile strength of mild steel, immunity to rust and high resistance to other forms of corrosion. This metal is furnished in four standard alloys; for hot working, cold working, screw machine production, and sand casting. Manufactured to U.S. Army and Navy Specifications, Everdur 1010 tube is being extensively used for high pressure hydraulic control lines, fuel and oil lines. The high strength and high resistance to fatigue of Everdur tube provide especially suitable qualities for this type of application. Contact rings for electrical controls on variable pitch propellers are also made of this versatile material, as are many types of bolts, nuts, screws and other fastenings.

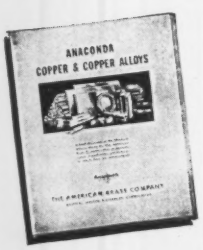


Fastenings of Everdur . . strong, tough, rustless, corrosion resistant.

BERYLLIUM COPPER: For 11 years The American Brass Company has been producing a wrought alloy of copper and beryllium. This metal, Anaconda Beryllium Copper, responds to heat treatment to a far greater degree than any other copper alloy, and possesses physical properties in excess of those of other copper base metals. It has excellent spring properties, high tensile strength and endurance limit, and good electrical conductivity. Because Anaconda Beryllium Copper can be worked and formed in its soft annealed state and then greatly strengthened and hardened by heat treatment, it has many useful applications in instruments, gages, aerial camera parts and other aircraft equipment.

Wright Cyclone Engine parts made of Anaconda Beryllium Copper.

*Trade Mark Reg. U.S. Pat. Off.



"ANACONDA COPPER AND COPPER ALLOYS"

This booklet, PUBLICATION B-28, provides general constants, physical and chemical properties and descriptions of all standard Anaconda Products. A copy will be mailed on request. The inside pages of this insert show where Anaconda Metals are going in the Aircraft Industry—and why.

Anaconda Copper & Copper Alloys
made by THE AMERICAN BRASS COMPANY

ALL AMERICAN BRASS CO. PLANTS IN THE U.S.A. HAVE EARNED THE RIGHT TO FLY ARMY-NAVY "E" FLAGS

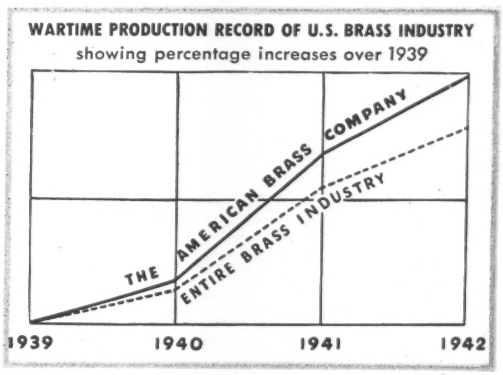
A 100% RECORD

Awards on May 8th, 1943 to two plants in Kenosha, Wis., completed this 100% record for The American Brass Company.

This is the story in terms of war production

Our Connecticut plants were among the first in the brass industry to receive the coveted "E" Award for outstanding production of war materials. Since then *all* our plants, including those in the States of Michigan, Wisconsin and New York, have been similarly honored.

As the largest fabricator in the copper and brass field, The American Brass Company is keenly aware of its responsibility to serve the cause of the United Nations.



This chart*, based on 1939 peacetime production, shows the rapid swing into all-out war production, both by the copper and brass fabricating industry and The American Brass Company (not including Government-owned plants). All-time production records have been continually broken ever since the National Defense Program was initiated in 1940.

*Based on compilations of The American Bureau of Metal Statistics

Since 1939, production has been tripled, with virtually every pound today going for war purposes.

This record was accomplished by close cooperation between management and labor . . . careful planning for rapid conversion to wartime operations . . . intensive training of new personnel . . . plus efficient utilization of existing and new plant equipment.

Detailed figures, of course, cannot be revealed, but The American Brass Company is consistently breaking all previous volume records. In addition to its U.S. plants and that of a Canadian subsidiary, Anaconda American Brass Ltd., the company's production also embraces three plants operated for the United States and Canadian Governments.

Shipments this past January were the largest in the company's history. March exceeded January. The first quarter of '43 was by far the greatest tonnage quarter in the records of the company.

The American Brass Company is proud indeed that all the plants it operates in the U.S.A. have won the honor of flying the Army-Navy "E" for excellence in production. But it is even prouder of the organization and the will-to-produce that have made this record possible . . . *and will keep it going.*

ANACONDA
from mine to consumer
REG. U.S. PAT. OFF.

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut *Offices and Agencies in Principal Cities*

Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

43194

Printed in U.S.A.

Macrid

Directory of Materials

SUPPLEMENT TO MACHINE DESIGN, OCTOBER, 1943

Contents

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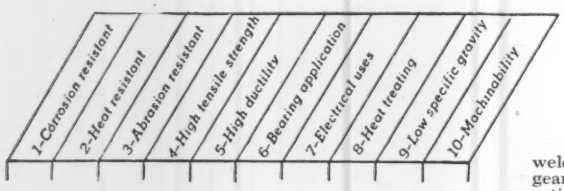
CONSTANTLY changing picture with respect to materials necessitates having the latest information on all types of materials and their characteristics at the finger tips of every designer. Such data are contained in this DIRECTORY OF MATERIALS in a condensed but useful manner. Above each tradename listed is a convenient key of numerals to classify the major properties of the material and to aid in selection.

Reference to the cross indexes for metals on Pages 184 and 186 as well as for plastics and other nonmetallics on Page 198 gives the designer a handy listing of similar materials produced by other suppliers, or of possible alternatives. Also, both the metallic and nonmetallic sections are cross referenced with separate listings of producers.

As with previous issues, reprints of this directory are available at a nominal cost of twenty-five cents.

Iron, Steel and Nonferrous Metals Listed by Tradenames

(For listing by producing companies, and complete street addresses, see Page 181)
For index of alloys by principal constituents, see Page 184)



A

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ABRASOWELD—Lincoln Electric Co., Cleveland. Arc-welding electrode for providing abrasion-resisting, self-hardening deposit which hardens rapidly under impact and abrasion; maximum hardness develops at surface, leaving cushion of softer metal beneath; provides resistance to abrasion in straight carbon, low alloy or high manganese steel surfaces; effective on gear and pinion teeth.

- - - 4 5 6 - - - -

ACORN — A. W. Cadman Mfg. Co., Pittsburgh. Babbitt metal furnished in ingots; brinell hardness, 70 degrees Fahr. 23.8 212 degrees Fahr. 21.8; compressive strength, 12,500 lb. per sq. in.; for bearings having reciprocating motion, subject to excessive pound or vibration.

- - - - - - 7 - - - -

ADAMANT SUPER-GENUINE BABBITT—Magnolia Metal Co., Elizabeth, N. J. Over 90 per cent tin, free of lead, containing special fluxes; furnished as ingots; specific gravity, 7.34; bearing properties, good: brinell hardness, untreated 23; used for bearings, diesel engines, connecting rods, etc., subject to shock or strain.

- - 3 - - - - - - -

ADAMANTINE—Babcock & Wilcox Co., New York. Special steel castings with wear-resisting qualities and machinable surfaces; for grinding mills, mixers, conveyors, power shovels.

- 2 - - - - 7 - - -

ADVANCE—Driver-Harris Co., Harrison, N. J. Copper 55, nickel 45; resists heat to 1500 degrees Fahr.; thermocouple material. For application where low temperature coefficient of resistivity is required; also for measuring instruments, industrial and radio rheostats and elevator controls.

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AERISWELD—Lincoln Electric Co., Cleveland. Arc-welding electrode; for welding of bronze, brass and copper, either in manufacturing or maintenance work.

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AGILE-ACTARC—American Agile Corp., Cleveland. Light-gage electrodes for sheet metal welding; fillet welding electrodes; for cast-iron welding, hard-surfacing and other purposes.

See advertisement, Page 242

1 2 - - - 6 - - - -

AGRICOLA — Saginaw Bearing Co., Saginaw, Mich. Bearing bronze of copper 70, lead 30; impurities less than .2 of 1; resists corrosion caused by acids; resists heat to 500 degrees Fahr.; ductility, medium; especially adapted to diesel and airplane engine bearings.

See advertisement, Page 114

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AJAX-HAMILTON Gear Bronze—The Ajax Metal Co., Philadelphia 23. Copper 90, nickel 2, antimony 8 (nominal); furnished in rough bars or billets and ingots; ult. tensile strength, 31,900 lb. per sq. in.; yield point, 19,000; elongation 7½ per cent; brinell hardness, 81-99; specific gravity, 8.16; nonmagnetic; weldability, fair; long wearing; used for gears. Will substitute for all bronze specifications hitherto in use for gears.

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ALCLAD—Aluminum Co. of America, Pittsburgh. Duplex aluminum and aluminum base alloys. An example is sheet with a high-strength core (ALCOA alloy 17S or 24S) and a coating of relatively high-purity aluminum with high resistance to corrosion.

1 2 3 4 5 6 7 8 - 10

ALCOA—Aluminum Co. of America, Pittsburgh. Aluminum wrought and casting alloys as follows:

1 - - - 5 - 7 - - -

2S; commercially pure aluminum sheet and plate, rod and bar, wire, tubing, extruded shapes and rivets; ult. tensile strength, 13-24,000 lb. per sq. in.; for sheet metal work, chemical equipment and electrical conductors.

3S; manganese 1.2; in sheet and plate, rod and bar, wire, tubing, extruded shapes, rivets; ult. tensile strength, 16-29,000 lb. per sq. in.; for sheet metal work, gasoline tanks for aircraft, rivets and tubing.

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11S-T3; copper 5.5, lead .5; heat-treatable wire, rod and bar, forgings, screw machine products; ult. tensile strength, 49,000 lb. per sq. in.

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14S-T; copper 4.4 silicon .8, manganese .8, magnesium .4; heat-treatable forgings; ult. tensile strength, 70,000 lb. per sq. in.; for heavy-duty forgings, power shovel bails and airplane fittings.

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17S; copper 4, manganese .5, magnesium .5; sheet and plate, rod and bar, wire, tubing, rolled and extruded shapes, rivets, forgings and screw machine products; ult. tensile strength, 26-62,000 lb. per sq. in.; for structural applications in construction and transportation fields.

- 2 - 4 - - - 8 - -

18S-T; copper 4, magnesium .5, nickel 2; heat-treatable forgings; ult. tensile strength, 63,000 lb. per sq. in.; used for forged aircraft engine pistons where good strength at elevated temperatures are required.

1 - - 4 - - - 8 - -

24S; copper 4.6, manganese, .6, magnesium 1.5; in sheet and plate, alclad, rod and bar, wire, tubing, extruded shapes, rivets; ult. tensile strength, 26-70,000 lb. per sq. in.; for structural construction in aircraft.

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25S-T; copper 4.5, silicon .8, manganese .8; forgings for airplane propellers; ult. tensile strength, 57,000 lb. per sq. in.

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32S-T; copper .9, silicon 12.5, magnesium 1.0, nickel .9; heat-treatable forgings for pistons; ult. tensile strength, 56,000 lb. per sq. in.

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A51S-T; silicon 1, magnesium .6, chromium .25; heat-treatable forgings for machine and automotive parts; ult. tensile strength, 47,000 lb. per sq. in.

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52S; magnesium 2.5, chromium .25; furnished in sheet and plate, rod, bar, wire and tubing for sheet metal work, marine and transportation applications; ult. tensile strength, 29-41,000 lb. per sq. in.

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53S; silicon .7, magnesium 1.3; chromium .25; furnished in sheet and plate, rod and bar, wire, tubing, rolled and extruded shapes, rivets, screw machine parts and forgings; ult. tensile strength, 16-39,000 lb. per sq. in.; excellent corrosion resistance, better combination of strength and workability than 52S.

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61S; copper .25, silicon .6, magnesium 1, chromium .25; ult. tensile strength, 18-45,000 lb. per sq. in.; in sheet and plate; extruded shapes and tubing; used as substitute for 53S when good machinability is desired and lower corrosion resistance acceptable.

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13; silicon, 12; ult. tensile strength, 33,000 lb. per sq. in.; a general purpose alloy for large, intricate parts.

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43; silicon 5; ult. tensile strength, 29,000 lb. per sq. in.; available as sand, permanent mold and die castings; used where castings must be leakproof under pressure.

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81; copper 7, silicon 3; ult. tensile strength, 32,000 lb. per sq. in.; for general purpose castings.

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83; copper 2, silicon 3; ult. tensile strength, 30,000 lb. per sq. in.; available as die castings for parts requiring moderate ductility.

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85; copper 4, silicon 5; ultimate tensile strength, 35,000 lb. per sq. in.; for brackets, frames and levers with thick sections.

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93; copper 4, silicon 2, nickel 4; ult. tensile strength, 33,000 lb. per sq. in.; furnished as die castings for parts requiring considerable polishing and machining.

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218; magnesium 8; ult. tensile strength, 38,000 lb. per sq. in.; furnished as die castings for marine fittings, etc.

108; copper 4, silicon 3, zinc 1.7; furnished as sand castings for manifolds, valves and other intricate castings requiring pressure tightness; ult. tensile strength, 21,000 lb. per sq. in.

A108; copper 4.5, silicon 5.5; furnished as permanent-mold castings for general purpose castings of intricate design; ult. tensile strength, 28,000 lb. per sq. in.

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112; copper 7, zinc 1.7, iron 1.2; furnished as sand castings for crankcases, oilpans, cylinder heads, and other automotive applications; ult. tensile strength, 23,000 lb. per sq. in.

B113; copper 7, silicon 1.7, iron 1.2; available in permanent-mold castings for machinery parts, and general-purpose castings; ult. tensile strength, 28,000 lb. per sq. in.

C113; copper 7, silicon 3.5, zinc 2, iron 1.2; permanent-mold castings for automotive-engine cylinder heads; ult. tensile strength, 30,000 lb. per sq. in.

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122; copper 10, magnesium .2, iron 1.2; heat-treatable sand and permanent-mold castings for automotive pistons, camshaft bearings, valve tappet guides; ult. tensile strength, 31-48,000 lb. per sq. in.

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A132; copper .8, silicon 12, magnesium 1, nickel 2.5 and iron .8; heat-treatable permanent mold castings for pistons; ult. tensile strength, 36-38,000 lb. per sq. in.

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138; copper 10, silicon 4, magnesium .2, iron 1; permanent mold castings for brake drums and pistons; ult. tensile strength, 28,000 lb. per sq. in.

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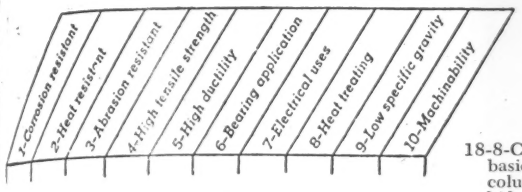
142; copper 4, magnesium 1.5, nickel 2; heat-treatable sand and permanent-mold castings; for pistons and aircooled cylinder heads; ult. tensile strength, 40-47,000 lb. per sq. in.



172; copper 8, silicon 2.5, sand castings for match plates and metal patterns; ult. tensile strength 23,000 lb. per sq. in.

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195; copper 4.5; heat-treatable sand castings with good combination of strength and shock resistance; ult. tensile strength, 31-40,000 lb. per sq. in.

B195; copper 4.5, silicon 2.5; heat-treatable permanent-mold castings; ult. tensile strength, 40-45,000 lb. per sq. in.

212; copper 8, silicon 1.2, iron 1; sand castings; ult. tensile strength, 22,000 lb. per sq. in.

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214; magnesium 3.8; sand castings for carburetor cases and machine parts; ult. tensile strength, 25,000 lb. per sq. in.

A214; magnesium 3.8, zinc 1.8; permanent-mold castings for marine fittings; ult. tensile strength, 27,000 lb. per sq. in.

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220; magnesium 10; heat-treatable sand castings for aircraft fittings, railroad car parts, heavy-duty castings and marine applications; ult. tensile strength, 45,000 lb. per sq. in.

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355; copper 1.3, silicon 5, magnesium .5; heat-treatable sand and permanent-mold castings for cylinder heads and crankcases for diesel and liquid-cooled aircraft engines; ult. tensile strength, 28-35,000 lb. per sq. in.

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356; silicon 7, magnesium .3; heat-treatable sand and permanent-mold castings; for high-strength, pressure-tight castings of intricate shapes; ult. tensile strength, 28-40,000 lb. per sq. in.

645; copper 2.5, zinc 11, iron 1.2; sand castings for machine parts not subject to high temperatures or corrosive conditions; ult. tensile strength, 29,000 lb. per sq. in.

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ALCUMITE — Duriron Co. Inc., Dayton, O. Copper 90, aluminum 9, iron 1; for pumps, valves, pipe, fittings, bars and castings for corrosive service where a copper base alloy is preferred.

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ALLEGHENY LUDLUM — Allegheny Ludlum Steel Corp., Brackenridge, Pa.

"4750"; a high permeability nickel-iron alloy containing approximately 48 per cent nickel, balance iron, that must be hydrogen annealed after fabrication. Available in form of sheets, flats, squares, strip, etc.; also in the form of laminations and shields. Used in audio transformers, sensitive relays, and electrical instruments.

"88"; a nonmagnetic high-strength alloy material, not at all stainless, which finds applications for mountings in power transformers, and on high-current bus boards in power generating stations and substations. Typical analysis—carbon .3; manganese 10, nickel 8, balance iron.

Electrical steels; furnished in coiled strip and sheets for manufacture of laminations. Used in construction of motors, transformers, relays, electromagnets, radios, etc. These steels contain ½-5 per cent silicon, depending on the application.

Relay steels; annealed silicon steel rounds, flats, squares, etc., containing ½-2¾ per cent silicon, which find wide application for relays, electromagnets, etc.

Laminations for transformers, motors, and miscellaneous small electrical equipment and parts. Made from all grades of silicon steel and from high permeability alloys, such as Allegheny-Ludlum "4750" and Allegheny Ludlum Mumetal.

Cast resistance grids; No. 17 metal. Castings having high electrical resistance and ability to withstand continued severe mechanical shock even at high temperatures. Applications include motor starters, crane motor controls, mine locomotive controls, and power house equipment.

See advertisement, Page 235

1 - - 4 - - - - - -

ALLEGHENY METALS—Allegheny Ludlum Steel Corp., Brackenridge, Pa.

18-8, type 302; chromium 18, nickel stainless alloy 8, which is non-magnetic and has corrosion resistance. Used for the same applications as No. 88 but where corrosion resistance is a necessary requirement.

18-8-C, type 347; chromium 17-19, nickel 9-12; basic 18-8 analysis modified by addition of columbium for stabilization within the carbide precipitation range of 800-1500 degrees Fahr.

18-8-M, type 317; carbon .1 max., chromium 16-18, nickel 10-14; basic 18-8 analysis modified by addition of molybdenum for increased corrosion resistance.

18-8-EZ, type 303; carbon .2 max., chromium 17-19, nickel 8-10; basic 18-8 analysis modified to improve machining properties.

20-10-S, type 308; carbon .08 max., chromium 19-21, nickel 10-12; a chromium-nickel stainless steel designed for certain applications requiring slightly higher general corrosion resistance than that of 18-8 steel.

25-12, type 309; carbon .2 max., chromium 22-24, nickel 12-15; a chromium-nickel stainless steel for elevated temperature applications requiring ease of fabrication and a high degree of oxidation resistance and high strength and creep values up to 2000 degrees Fahr.

25-20, type 310; carbon .25 max., chromium 24-26, nickel 19-22; a chromium-nickel steel similar to type 25-12 but exhibiting greater stability due to its higher alloy content. Coefficient of expansion is closer to that of plain steel than those of the other chromium-nickel alloys listed. Offers resistance to oxidation to 2100 degrees Fahr.

12, type 410; carbon .15 max., chromium 11.5-13.5; a high strength chromium stainless steel possessing excellent resistance to corrosion and to oxidation in the range 1200-1500 degrees Fahr. A type which responds to heat treatment.

12-EZ, type 416; carbon .15 max., chromium 12-14; similar to type 410 but modified to improve machining properties.

12-TB, type 403; carbon .15 max., chromium 11.5-13; a high strength chromium steel widely used to meet requirements of turbine construction which calls for high elastic limit and impact values.

12-2, type 414; carbon .15 max., chromium 11.5-13.5, nickel 1.25-2.5 max.; a high strength chromium steel with small nickel content possessing properties of basic Allegheny Metal 12 steel, but with more definite response to heat treatment.

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17, type 430; carbon .12 max., chromium 14-18; a low-carbon, high-chromium structural stainless steel possessing high degree of resistance to chemical and atmospheric corrosion and oxidation up to 1600 degrees Fahr., together with high strength and ease of fabrication.

17-EZ, type 430F; carbon .12 max., chromium 14-18; similar to Allegheny Metal 17 but modified to improve machining properties.

21, type 442; carbon .35 max., chromium 18-23; a straight chromium steel designed primarily for high temperature service in applications not involving difficult fabrication.

28, type 446; carbon .35 max.; chromium 23-30; a straight chromium steel which offers excellent resistance to chemical corrosion and to oxidation up to 2150 degrees Fahr.

H-17, type 440C; carbon .95-1.2, chromium 16-18; a 17 per cent chromium alloy steel with high carbon which through heat treatment develops maximum hardness and wear resistance, together with high strength and corrosion resistance.

M-17, type 440A; carbon over .12, chromium 16-18; an alloy similar to H-17 but with lower carbon, possessing increased resistance to corrosion and higher impact values with somewhat lower hardenability.

L-12, type 420; carbon over .15, chromium 12-14; a stainless steel which, due to its higher carbon content, can be heat treated to greater hardness than Allegheny Metal 12 and 12-2 with but slight impairment of the corrosion-resistant qualities of either.

46, types 501 and 502; carbon for 501 over .1 and for 502, .1 max.; chromium for both types 4-6; a low chromium structural steel possessing strength and corrosion and oxidation-resistance intermediate to those of plain carbon steel and the regular stainless steels. Available with molybdenum for increasing tensile and creep strengths at high temperatures.

See advertisement, Page 235

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ALNICO — General Electric Co., Schenectady, N. Y. Permanent magnet alloy of high coercive force; nickel 20-30 per cent, aluminum 10-12, cobalt 3-5, balance iron; extremely hard and difficult to machine. Available in both sintered and cast form. Sintered Alnico furnished by General Electric and cast Alnico by the folllowing: Arnold Engineering Co., Chicago; Belden Mfg. Co., Chicago; Cinaudagraph Corp., Stamford, Conn.; Crucible Steel Co. of America, New York; General Magnetic Corp., Chicago; Indiana Steel Products Co., Chicago; Simonds Saw & Steel Co., Lockport, N. Y.; Taylor-Wharton Iron & Steel Co., High Bridge, N. J.; and Thomas and Skinner Steel Products Co., Indianapolis.

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ALUMINWELD—Lincoln Electric Co., Cleveland. A 5 per cent silicon-aluminum-alloy electrode for arc-welding aluminum in any form—cast, sheet, shapes, or extruded forms. For either metallic or carbon arc welding. Welds are very dense without porosity and possess high tensile strength.

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AMBRAC — American Brass Co., Waterbury, Conn. Alloy 850; copper 75, zinc 5, nickel 20; high ductility; used for condenser tubes, etc.

See advertisements, Pages 147-153

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AMERCUT—American Steel & Wire Co., Cleveland. Cold finished carbon and alloy steel bars either cold drawn, annealed, normalized, spheroidized or quenched and tempered to meet various combinations of definite physical, magnetic, corrosion-resistant or machinability property specifications; for screw machine use or shafting.

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AMERICAN—American Nickeloid Co., Peru, Ill. Bonded metals; chromium, nickel, brass, copper, gold resemblance and colors bonded to base metals such as steel, tin-plate, zinc, brass, copper, aluminum and nickel silver. Available in brilliant finishes and patterns as sheets, flat strips, coiled strip and round edge flat wire. Can be supplied with gum adhered paper covering protecting prefinish in drawing and preforming.

Copper steel; copper plated to steel, latter serving as rust-resistant, inexpensive metal, conserving quantities of critical solid copper. Available in polished and unpolished finishes in sheets, flat strips and coiled strip for continuous feed automatic presses.

Zinc-plated steel; a rust-resistant and corrosion-resistant metal used as a practical alternate for nickel, tin, aluminum, brass and copper. Available in polished and unpolished finishes in sheets and flat strips, in a wide range of gages.

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AMERICAN QUALITY—American Steel & Wire Co., Cleveland. Carbon steels and alloys in the form of cold-rolled strip, manufacturer's wire and springs.

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AMOLA—Chrysler Corp., Detroit. Also made by various steel companies as licensees under patent controlled by Chrysler Corp. Machinery and constructional steels furnished in 20 grades which vary in analyses only in regard to carbon content. Basically the analysis is manganese .7-.9, phosphorus (max.) .04, sulphur (max.) .04, silicon .2-.3, and molybdenum .15-.25. Used for carburized gears, axle shafts, and springs, with as little thickness as 5/1000 of an inch.

MS 244 electric furnace, carbon .66-.7.

MS 245 open hearth; entire formula same as MS 244.

MS 246 electric furnace; carbon .6-.65.

MS 247 open hearth; carbon same as MS 246.

MS 248 electric furnace; carbon .55-.6.

MS 249 openhearth; carbon same as MS 248.

MS 260 electric furnace; carbon .5-.55.

MS 261 open hearth; carbon same as MS 260.

MS 262 electric furnace; carbon .45-.5.

MS 263 open hearth; carbon same as MS 262.

MS 266 electric furnace; carbon .4-.45.

MS 267 open hearth; carbon same as MS 266.

MS 268 electric furnace; carbon .35-.4.

MS 269 open hearth; carbon same as MS 268

MS 270 electric furnace; carbon .3-.35.

MS 271 open hearth; carbon same as MS 270.

MS 276 electric furnace; carbon .25-.3.

MS 277 open hearth; carbon same as MS 276.

MS 290 electric furnace; carbon .20-.25.

MS 291 open hearth; carbon same as MS 290.

1-Corrosion resistant | 2-Heat resistant | 3-Abrasion resistant | 4-High tensile strength | 5-High ductility | 6-Bearing application | 7-Electrical uses | 8-Heat treating | 9-Low specific gravity | 10-Machinability

1 - 3 4 5 6 - - - -

AMPCO METAL—Ampco Metal Inc., Milwaukee 4. Special copper-base alloys for wear and corrosion-resistant service; produced in seven grades.

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Grade 12; copper 88.2, aluminum 8.6, iron 2.9, others .3; furnished in rods, bars, sheets, and plates; for hot forging, turning, boring and welding; also as sand or centrifugal castings; corrosion-resistant; resists heat to 1000 degrees Fahr.; low abrasion resistance; tensile strength, 65,000 lbs. per sq. in.; compressive, 120,000; high ductility; specific gravity, 7.735; good bearing properties; nonmagnetic; brinell hardness 115; for use as bushings and bearings.

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Grade 16; copper 86.2, aluminum 10.2, iron 3.3, others .3; furnished in rods, bars, sheets and plates; for hot forging, turning, boring and welding; also as sand or centrifugal castings; corrosion-resistant; resists heat to 1000 degrees Fahr.; medium abrasion resistance; tensile strength, 75,000 lb. per sq. in.; compressive. 125,000; high ductility; specific gravity, 7.628; good bearing properties; nonmagnetic; fair weldability; brinell hardness, heat treated, 137; used for bearings, gears, wormwheels, liners, lead screw nuts—all for heavy duty where exceptional resistance to wear is required.

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Grade 18; copper 84.6, aluminum 11.3, iron 3.2, others .4; furnished in rods, bars, sheets and plates; for hot forging, turning, boring, and welding; also as sand or centrifugal castings; corrosion-resistant; resists heat to 1000 degrees Fahr.; tensile strength 80-85.000 lb. per sq. in.; compressive, 136,000; medium ductility; good bearing properties; nonmagnetic; brinell hardness, heat treated, 173; for use as heavy-duty, wear-resistant gears, worm-wheels, feed nuts, bearings, welding bases and pickling equipment.

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Grade 18-23; aluminum 10.6-11.2, iron 3.4-4, others .4 max., copper balance; furnished in rough bars or billets and as sand casting for hot forging; resists heat to 750 degrees Fahr.; high abrasion resistance; tensile strength, 95-105.000 lb. per sq. in.; good bearing properties; weldability, good; used for parts requiring high strength, good bearing and wearing resistance.

1 - - 4 - 6 - - - -

Grade 20; copper 83.13, aluminum 12.40, iron 4.07, and others .4; available as sand and centrifugal castings; corrosion-resistant; resists heat to 1000 degrees Fahr.; high abrasion resistance; tensile strength. 85,000 lb. per sq. in.; compressive. 146 000; specific gravity, 7.437; good bearing properties; nonmagnetic; brinell hardness, untreated, 241; for use as cams and cam rollers, welding jaws, bushings, bearings, and other wear-resistant parts.

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Grade 21; copper 82.34, aluminum 13.02, iron 4.14, others .5; available as sand and centrifugal castings; resists heat to 1000 degrees Fahr., high abrasion resistance; tensile strength, ult.. 90 000 lb. per sq. in.; compressive, 160.000; ductility, low; specific gravity. 7.152; fair bearing properties; nonmagnetic, brinell hardness, untreated, 311; for use as forming and drawing dies. bushings and bearings replacing hardened steel.

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Grade 22; copper 81.67, aluminum 13.42, iron 4.41, others .5; available as sand and centrifugal castings; resists heat to 1000 degrees Fahr.; high abrasion resistance; tensile strength, 90,000 lb. per sq. in.; compressive, 171,000; low ductility; specific gravity, 7.125; fair bearing properties; nonmagnetic; brinell hardness, untreated, 335; for use as forming and drawing dies.

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Grade 45; copper 80.55, aluminum 10.26, iron 3.14, nickel 4.82 and manganese 1.18. Furnished in rough bars or billets and finished rods and bars. Extruded or heat treated. Tensile strength, 105,000 lb. per sq. in. under 1-inch diameter; yield strength, 55,000; elongation, 8 per cent; brinell hardness, 225. In heat-treated form meets AMS 4640.

See advertisement, Page 137

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AMPCO-TRODE—Ampco Metal Inc., Milwaukee. Coated welding rods in the six aluminum bronze alloys, listed under Ampco Metal. Used for welded overlays on steel and cast iron for bearing or corrosion resisting purposes for welded fabrication of aluminum bronze or brass sheets and castings.

See advertisement, Page 137

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AMPCOLOY — Ampco Metal Inc., Milwaukee. Various grades of copper-base alloys.

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Grade E-1; copper 89, aluminum 10, iron 1; furnished in rough bars or billets, rods or bars; for sand casting, hot forging, extruding, turning, boring, and as centrifugal castings. Resists corrosion caused by acids and other corrosives; resists heat to 1000 degrees Fahr.; medium abrasion-resistant; tensile strength, ult., 70-80,000 lb. per sq. in.; compressive, 136,000; ductility, high; specific gravity, 7.48; bearing properties, good; nonmagnetic; used for gears, pickling equipment, bearings, screw down nuts.

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Grade E-123; same analysis as E-1; furnished in rough bars or billets and finished rods and bars; for sand casting, hot forging, turning, boring, and as centrifugal castings. Resists heat to 1000 degrees Fahr.; medium abrasion-resistant; tensile strength, ult, 90,000 lb. per sq. in.; compressive, 145,000; ductility, medium; specific gravity, 7.48; bearing properties, good; nonmagnetic; weldability, fair; for gears, worm wheels, nuts and bearings.

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Grade A-3; similar analysis to E-1; furnished in rough bars or billets, finished rods or bars and plates; for sand casting, hot forging, turning, boring, and as centrifugal castings. Resist corrosion caused by acids and other corrosives; resists heat to 1000 degrees Fahr.; medium abrasion-resistant; tensile strength, 75,000 lb. per sq. in.; compressive, 135,000; ductility, high; bearing properties, good; nonmagn tic; weldability, good; brinell hardness, untreated, 120; for gears, forgings, bushings, bearings, and pressure parts. Heat treated will meet Fed. Spec. QQ-B-671 Grade B; extruded meets AMS 4630.

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Grade A-323; same analysis as A-3; furnished in rough bars or billets, finished rods or bars and plates; for sand casting, hot forging, turning, boring, and as centrifugal castings. Resists corrosion caused by mild corrosives; resists heat to 1000 degrees Fahr.; medium abrasion-resistant; tensile strength, ult., 85,000 lb. per sq. in.; compressive, 136,000; ductility, high; specific gravity, 7; bearing properties, good; nonmagnetic; weldability, good; used for gears, bushings, bearings, sleeves and forks.

See advertisement, Page 137

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AMSCO—American Manganese Steel Div., American Brake Shoe Co., Chicago Heights, Ill.

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Manganese steel; 10-14 manganese, 1-1.40 carbon, balance iron; suitable for sand casting; for power shovel dippers and teeth, rock crusher parts, dredge pumps, etc.

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Alloy F-1; 15-18 chromium, 34-37 nickel; for molten metal containers, liquid containers, and furnace parts for heat treating, especially under frequent and drastic temperature changes; heat-resistant to 2100 degrees Fahr.; creep resistant at high temperatures.

F-3; 26-29 chromium, 3 max. nickel; for rabble arms and blades, sintering bars, etc.; heat-resistant to 1800 degrees Fahr. where temperature changes are not wide and high unit strength is not essential, and where high sulphur fuels are used.

F-5; 17-20 chromium, 64-70 nickel; furnace conveyor pans, heat-treating boxes, enameling fixtures, etc.; similar properties to F-1 and F-6, except tougher and more resistant to temperature fluctuations.

F-6; 12-15 chromium, 58-64 nickel; for heat-treating boxes, retorts, etc.; where temperature changes or uneven heating are severe.

F-8; 19-22 chromium, 7.5-10.5 nickel; for mine water and acid pump parts, marine fittings, chemical mixer and paper mill digester parts. Heat-resistant to 1600 degrees Fahr.

F-10; 26-28 chromium, 10-13 nickel; for heat-treating furnace shafts, dampers and valves, cement kiln cooler parts, etc.; creep-resistant at high temperatures; where temperature changes are not severe; and where high sulphur fuels are used.

F-12; 27-30 chromium, 7-10 nickel; same as F-10 except when sulphur is very high.

F-13; 25-28 chromium, 34-37 nickel; for temperatures up to 2100 degrees Fahr., with sulphur present.

F-14; 24-27 chromium, 19-22 nickel; for high temperatures under carburizing conditions with some sulphur present.

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Nickel-manganese steel; 13-15 manganese, .70-.90 carbon, .95-1.20 silicon, 3.50-4.50 nickel; welding-rod for building up and strength welding of austenitic manganese steel castings.

Farmface; chromium, manganese, silicon, hard alloy welding-rod for hard-surfacing agricultural machinery and other ferrous wearing parts.

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No. 459; chromium molybdenum hard alloy welding-rod for hard-surfacing machinery wearing parts; deposits are 500-600 brinell.

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No. 217; chromium-molybdenum-tungsten welding-rod for hard-facing cast wearing parts; extreme hardness and great wear resistance.

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Dieweld; a chromium-molybdenum welding-rod for building up forming dies, cutting tools, punches, shear knives, etc.

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Economy hardface; self-hardening, chromium-molybdenum-high carbon welding-rod manufactured coated for alternating or direct-current electric welding and bare for oxy-acetylene deposition; used for applications where extreme impact and abrasion are encountered.

1 2 3 4 5 6 7 8 - 10

ANACONDA — American Brass Co., Waterbury, Conn. Many copper base alloys, as well as pure copper in various forms under this tradename are available, some of which are listed below.

1 - - - - 6 - 8 - -

Beryllium Copper; copper 97.50, beryllium 2.15, nickel .35; abrasion-resistant; high tensile strength and ductility; for springs, diaphragms, low duty bushings and bearings.

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"85" Red Brass; copper 85, zinc 15; pipe tube and sheet forms; particularly resistant to salt water corrosion.

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Super-Nickel; copper 70, nickel 30; seamless tubes, sheets and plates; for severe condenser tube service and resistance to salt water corrosion.

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Special Phosphor Bronze; copper 88, tin 4, zinc 4, lead 4; corrosion, heat and abrasion-resistant; combines general characteristics of standard phosphor bronze alloys with free cutting qualities of yellow brass.

See advertisements, Pages 147-153

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ANFRILOY—Wellman Bronze & Aluminum Co., Cleveland. A copper-lead-tin bearing bronze for high speed, light-duty bearings and for bushings where pressure and thrust are not excessive.

See advertisement, Page 233

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ANTIMONIAL ADMIRALTY — Chase Brass & Copper Co., Waterbury 91. Conn. Copper 71, tin 1, antimony .04, zinc 27.96. Outstanding for general corrosion resistance and particularly for preventing dezincification. Recommended for condensers in the power plant and oil industries.

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APOLLO—Apollo Metal Works, Chicago 38.

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Chromsteel; cold-rolled strip, nickel-chrome-plated steel, furnished in sheets and strips, for stamping into parts. Resists heat to 800 degrees Fahr.; abrasion resistance, medium; weldability, fair. Used generally as substitute for brass and copper sheet and other critical metals when resistance to corrosion is essential or reflectivity is needed.

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Zinc steel; corrosion-resistant sheet or strip, zinc-plated to engineering specifications; for stamping and welding. Resists corrosion caused by salt water. Has high tensile strength, and is used for bearing applications.

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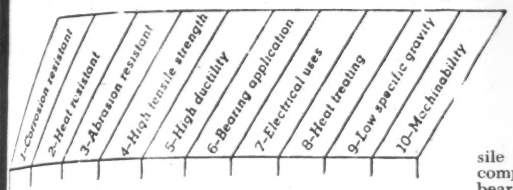
APOLLOY METAL — Apollo Steel Co., Apollo, Pa. Carbon .06-10, manganese .30-60, sulphur .045 max., phosphorus .04 max., copper .20 per cent min.; in sheets, for stamping and welding into parts; ult. tensile strength, 45-50,000 lb. per sq. in.; yield point 25-



30,000 lb. per sq. in.; abrasion resistance, low; hardness B 40 to 50 Rockwell.

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ARISTOLOY — Copperweld Steel Co., Warren, Ohio. Full range of S.A.E. alloy steels, also aircraft, and special steels; used for gears, both light and heavy-duty, clutches, shafts and pinions; also in ball and roller bearings and aircraft parts, both for engine and plane use; stainless and nitralloy steels. Company also produces aircraft steel, stainless, nitralloy, bearing steels, and carbon and alloy tool steels.

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ARMASTEEL—Saginaw Malleable Iron Division, Saginaw, Mich. Carbon 2.65, silicon 1.35, manganese .4, sulphur less than .15, phosphorus, less than .1; fabricated into parts by sand casting, and also available in castings; recommended heat treatment to suit customers' requirements; tensile strength, ult., to 100,000 lb. per sq. in.; yield point, to 85,000 lb. per sq. in.; elongation, to 8.0 per cent; hardness, brinell No. 163-302; Rockwell "C" to 55 on hardening; specific gravity, 7.2; for camshafts, rocker arms, diesel pistons, refrigerator parts, crankshafts, connecting rods, etc., other automotive and diesel parts, and Hydramatic transmission parts.

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ARMCO — American Rolling Mill Co., Middletown, O.

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Stainless steel, grade 18-8 (type 302, 304); 17-7 (type 301); 18-12 Mo. (type 316); 25-12 (type 309); 17 (type 430); 13 (type 410); 10-12 Mo. (type 317); 18-10 Cb (type 347); 18-10 Ti (type 321); and 27 (type 446); these can all be drawn and stamped; all machinable, abrasion-resistant and weldable.

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Armco High Strength; a low alloy, high-strength. Supplied in sheets, strip and plates; suitable for stamping and welding.

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Tran-Cor 58; high silicon steel for distribution transformers. Grade 65; steel sheets with low core loss for power and distribution transformers. Grade 72; a high silicon steel for large generators and transformers.

Intermediate Transformer; scale-free silicon steel sheet for some transformer and special applications.

Special Electric; scale-free medium steel sheet for a.c. motors and generators.

Electric; special analysis sheet for rotating machines.

Armature; steel sheet for small d.c. motors.

Field Grade; special sheet for intermittent duty fractional horsepower motors.

Radio No. 6; for applications in which superior low induction magnetic characteristics are important. No. 5; for audio transformer cores and other low induction applications. No. 4; good permeability at low induction; for chokes. Nos. 3, 2 and 1; for small transformers.

Ingot Iron; highly refined iron for magnetic cores; supplied in round and flat bar form.

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Armco Ingot Iron; highly refined iron supplied in galvanized sheet for general sheet metal work; also hot rolled annealed and cold rolled sheets, plates and strip.

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Armco Enameling Iron; highly refined iron for porcelain enameling uses; supplied in sheets.

Armco wrought steel wheels; one-wear, two-wear, multiple wear, heat-treated and stress resistant. Long mileage and safety factors; meet all A.A.R. or special specifications. Available from 18- to 48-inch diameters.

Aluminized; a special aluminum-coated sheet (strip or coil) with exceptional resistance to heat and corrosion.

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ASARCOLOY No. 7—American Smelting & Refining Co., New York. A cadmium-nickel bearing alloy capable of withstanding high compression loads and high operating temperatures. Nickel 1.3, balance cadmium. Furnished in ingots for spinning and permanent mold castings. Resists heat to 300 degrees Fahr.; high abrasion resistance; tensile strength, ult., 15,000 lb. per sq. in.; compressive, 20,000; specific gravity, 8.7; bearing properties, good; weldability, good; brinell hardness, untreated 33; used for bearings.

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ATLAS No. 93—Allegheny Ludlum Steel Corp., Brackenridge, Pa. Carbon .55, chromium .65, molybdenum .35; for collets, studs and parts requiring toughness in hardened condition. Oil hardening. For use as bucket teeth, keys, pins, bolts, studs, etc.

See advertisement, Page 235

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AUROMET — Aurora Metal Co., Aurora, Ill., special aluminum and silicon bronzes of several compositions.

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AVIALITE — American Brass Co., Waterbury, Conn. Copper-aluminum alloy for valve seats and guides in airplane motors.

See advertisement, Pages 147-153

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"AW" (rolled steel floor plate) — Alan Wood Steel Co., Conshohocken, Pa. Furnished in five patterns to meet flooring problems in the industrial and transportation fields; designed to withstand heaviest traffic; oilproof, crackproof, heatproof, slipproof, and noiseless. Furnished in carbon, copper or alloy analysis; also available in other nonferrous metals.

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"AW" DYN-EL—Alan Wood Steel Co., Conshohocken, Pa. Furnished in sheets, strips, and plates for stamping, welding, cold forming and hot forming, etc.; abrasion resistance, medium; tensile strength, 70-80,000 lb. per sq. in.; ductility, high; weldability, good; fatigue and impact values, high; for structures requiring high strength.

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B & W CROLOY—Babcock & Wilcox Tube Co., Beaver Falls, Pa.

1¼; carbon .15 max., chromium 1-1.5, molybdenum .45-.65, silicon .5-1; useful to 1000 degrees Fahr. in steam, slightly higher in oil refining; has fair creep-strength where limited corrosion and oxidation resistance are required.

2; carbon .15 max., chromium 1.75-2.25, molybdenum .45-.65, silicon .5 max.; for refinery and superheater tubes. Corrosion and heat-resistant at nominal temperatures.

2¼; carbon .15 max., chromium 2-2.5, molybdenum .9-1.1, silicon .5 max.; for refinery and superheater tubes where exceptionally high creep strength is required.

3M; carbon .15 max., chromium 2.75-3.25, molybdenum .8-1, silicon .5 max.; suitable from 1000 degrees Fahr. to 1050 degrees Fahr. in steam or to 1175 degrees Fahr. in refinery application; good creep properties and corrosion resistance superior to Croloy 2 or 2¼.

5; chromium molybdenum; carbon .15 max., chromium 4-6, molybdenum .45-65; for oil refinery service.

7; carbon .15 max., chromium 6-8, molybdenum .45-.65 for oil refinery service where increased corrosion resistance is required.

9; carbon .15 max., chromium 8-10, molybdenum 1.2 min.; semistainless alloy of good physical properties and corrosion resistance.

12 (type 410); carbon .15 max., chromium 12-14; resistant to atmosphere and acids; resists heat to 1500 degrees Fahr. and when heat treated has tensile strength of 180,000 lb. per sq. in.

18 (type 430); carbon .12 max., chromium 15-18; useful for certain elevated temperature applications but particularly for nitric acid plant equipment.

18-8S (type 304); carbon .08 max., chromium 18-20; nickel 8-11; low carbon; for high temperature work or corrosion-resistant service.

18-8S-Cb; carbon .08 max., chromium 18-20, nickel 8-11; low carbon; columbium stabilized 18-8S for welding or heating in carbide range; otherwise similar in properties to Croloy 18-8S.

18-8S-Ti; carbon .08 max., chromium 18-20, nickel 8-11; low carbon; titantium stabilized 18-8S; adaptable for welding without danger of sensitization toward intercrystalline corrosion; more stable on long heating at high temperatures.

16-13-3 (type 316); carbon .1 max., manganese 2 max., chromium 16-18, nickel 11-14; molybdenum 2-3; austenitic type alloy similar in many respects to 18-8S and 25-20; high strength at elevated temperatures; corrosion-resistant.

25-20 (type 310); chromium 25, nickel 20; high strength and high oxidation resistance; also excellent corrosion resistance.

27 (type 446); carbon .2 max., chromium 26-30, resistant to oxidation to 2100 degrees Fahr.; also corrosion-resistant.

See advertisement, Page 245

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BAKER — Baker & Co. Inc., Newark 5, N. J. Platinum and alloys for linings, contacts, thermocouples, furnace resistors, etc.

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BEARITE—A. W. Cadman Mfg. Co., Pittsburgh; babbitt metal furnished in ingots and 50-pound pigs; brinell hardness at 70 degrees Fahr. 29.1, 212 degrees Fahr. 24.4; compressive strength 15,000 lb. per sq. in.; for rotary bearings subjected to heavy loads and extreme speed.

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BEARIUM METAL — Bearium Metals Corp., Rochester, N. Y. Copper 70, tin 4, lead 26; furnished in rough bars or billets and as sand castings. Mechanical properties in untreated state; ult. tensile strength, 21,000 lb. per sq. in.; compressive, 9000; brinell hardness, 40; abrasion resistance, high; for all bearing applications.

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BECKETT METAL—Beckett Bronze Co., Muncie, Ind. Several grades of high lead bronze; copper 60-75, tin 3-9, lead 16-35, and nickel 0-1; furnished in rough bars and rods (cored or solid) for turning, boring, etc.; resists corrosion due to sulphuric-hydrochloric acid solutions, and resistant to heat to 400 degrees Fahr.; tensile strength 21-24,000 lb. per sq. in.; good bearing properties; brinell hardness, untreated, 36-46; used for bearings, bushings, and to a limited extent in seals, piston rings and gears.

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BELECTRIC—Belle City Malleable Iron Co., Racine, Wis. Furnished as sand castings; tensile strength 35-60,000 lb. per sq. in.; high compressive strength; good bearing properties; recommended heat treatments are the same as for standard gray iron; brinell hardness, untreated 179-285, heat treated 300-550; used where rigidity, wearability or where strong high grade gray iron might be applied.

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BELECTROMAL—Belle City Malleable Iron Co., Racine, Wis. High strength malleable iron furnished as sand castings; tensile strength 60-70,000 lb. per sq. in.; high ductility; brinell hardness, untreated 140-170; recommended for castings for automotive, railroad, tractor and implement work.

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BELMALLOY—Belle City Malleable Iron Co., Racine, Wis. Pearlitic malleable iron, electric furnace melted and continuous oven annealed; tensile strength, 70 000 lb. per sq. in. min.; yield point, 45,000 min.; elongation, 5 per cent min.; and brinell hardness, 179-217. Used for castings of machining quality requiring strength and shock resistance.

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BERALOY "A"—Wilbur B. Driver Co., Newark, N. J. Beryllium-copper alloy; copper 97.75, beryllium 2, and cobalt .25; furnished in soft annealed state or in slightly cold-worked conditions for easy machining and forming into parts. Tensile strength of 66,000 lb. per sq. in. in annealed state can be increased to 175,000 lb. per sq. in. by simple hardening treatment at 600 degrees Fahr., and by cold work after solution anneal, tensile strength can be increased to 200,000 lb. per sq. in. Used for electrical spring parts, contacts, switch jaws, diaphragms, switch parts, bearings, connectors, valves, cams, etc.

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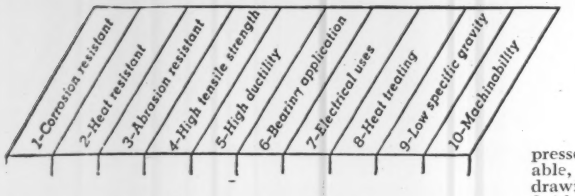
BERMAX BABBITT—Federal Mogul Corp., Detroit. A high lead babbitt; easy to use, cast and easy to handle in rebabbitting; melting point slightly higher than that of tin-base metals and can be cast by any method without fear of segregation; for use as bearing lining.



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BERYLCO No. 25—Beryllium Corp. of Pa., Reading, Pa. Beryllium 1.9-2.1, cobalt .15-.25, balance copper; furnished as rough bars or billets, finished rods or bars, strips, tubing, and wire; for sand casting, die casting, turning, boring, forging, stamping and welding; recommended heat treatment 600-650 degrees Fahr. for 2-3 hours depending on temper. Mechanical properties in heat-treated state: ult. tensile strength, 175,000-200,000 lb. per sq. in.; yield point, 146,000-179,000 lb. per sq. in.; elongation 2-10 per cent; impact resistance, high; specific gravity, 8.23 + or — .02; nonmagnetic; weldability, fair; resists corrosion caused by salt water and alkalies; heat resistant to 350 degrees Fahr.; abrasion resistance, high. Used for bushings, cams, gears, valve bodies, etc.

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BETH-CU-LOY—Bethlehem Steel Co., Bethlehem, Pa. A copper-bearing-steel resistant to atmospheric corrosion; for jackets, covers, machine guards, oil pans, etc.

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BETHLEHEM—Bethlehem Steel Co., Bethlehem, Pa.

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No. 235; abrasion-resistant, high-carbon-manganese-silicon steel of 235 brinell; for shovels, crushers, hoppers, scraper blades and conveyors.

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No. 88-80; chromium-molybdenum steel castings with high abrasion resistance for ball mill liners, rolls, tires, bottom plates, etc.

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Bearing steels; standard high-carbon, high-chromium ("52-100 type) for ball bearings and low-carbon nickel-molybdenum type for roller bearings. All grades can be processed to meet the requirements of automotive and industrial service.

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Magnet steels; high-carbon steels with varying chromium content, up to 6 per cent.

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BINNEY METAL—The Binney Castings Co., Toledo 7, O. Also known as Min-Ox. See listing under Min-Ox.

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BINNEY No. 71 and No. 73—The Binney Castings Co., Toledo 7, O. Heat-resisting alloy castings; weldability, good; heat-resistant to 2000 degrees Fahr.; abrasion resistance, high; used for construction parts for heat-treating furnaces and all applications requiring heat-resistant castings.

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BOHNALITE—Bohn Aluminum & Brass Corp., Detroit. Light alloy of which aluminum is the base; for forged connecting rods, cast cylinder heads, crankcases, transmission cases, and parts for vacuum cleaners, washing machines, shoe machinery, etc.

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BOROD—Stoody Co., Whittier, Calif. A rod made up of various screen sizes of irregularly shaped particles of tungsten carbide particles—40-125 screen size—contained in steel tubes. Offers maximum resistance to abrasion; hardness 9-10 on Moh's scale; provides maximum wear resistance on earth drilling and scraping equipment; also excellent for hard-facing small or thin parts such as coal cutter bits and cane knives.

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BOUND BROOK—Bound Brook Oil-Less Bearing Co., Bound Brook, N. J. Bushings, bearings and washers; cast bronze inlaid with hard graphite lubricant in grooves or holes of various designs; particularly adaptable to high temperatures, severe static loads, immersion in liquids, exposure to dusts or where oils are objectionable.

See advertisement, Page 246

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BRASSOID—American Nickeloid Co., Peru, Ill. Brass bonded to zinc, latter serving as rust-proof, flexible and inexpensive white metal base. Available in variety of brilliant finishes and patterns, as sheets, flat strips and coiled strip for continuous feed automatic presses. Can be supplied with quick removable, gum adhered paper covering permitting drawing and forming without marring prefinish.

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BRIDGEPORT COPPER AND ZINC ALLOYS—Bridgeport Brass Co., Bridgeport, Conn.

Yellow brass; copper 65, zinc 35; copper 70, zinc 30; sheet, wire and seamless tubing for drawing, stamping, and cold heading.

Cartridge brass; copper 70, zinc 30. Sheet for making small arms ammunition and artillery cartridge cases.

Free-cutting brass rod; copper 60, lead 3, balance zinc; for making automatic screw machine parts.

Forging rod-copper 60, lead 2, balance zinc.

Low brass; copper 80, zinc 20; pale golden color; for articles requiring greater ductility and malleability than possessed by yellow brass.

Commercial bronze; copper 90, zinc 10; bronze color for manufacturing stampings and drawn items and cold headed items, for outdoor use; stands weathering better than yellow brass; copper sheet, rod, wire, seamless tubing for miscellaneous manufacturing. Leaded brass alloys, containing from ¼-3.75 per cent lead to facilitate machining.

Phosphor-bronze; copper 92, tin 8; for spring parts; has better spring properties than lower tin content.

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Phosphor-bronze; copper 95, tin 5; sheet spring quality for manufacturing switch parts.

Copper in form of sheet and tube for fabricating.

Bronze welding rods in a variety of alloys for brazing iron and steel gears, frames, and other broken machine parts; for welding silicon bronze tanks.

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BRIDGEPORT TUBING—Bridgeport Brass Co., Bridgeport, Conn.

Condenser tubing; available in Admiralty metal for sea water, Cuzinal (aluminum brass) for harbor water, Muntz metal for fresh water, Duronze IV for aerated brackish water, Cupro-Nickel for most severe service and U. S. Navy requirements, and Arsenical copper for resisting corrosion better than straight copper.

Duplex tubing; for two different types of corrosion inside and outside of tubing which are too severe for a single alloy. Steel, stainless steel, aluminum on outside or inside in combination with Admiralty brass, aluminum brass, copper or cupro nickel, used for oil refining, refrigeration systems, chemical plants and food processing.

Copper water tubing; for industrial applications, and for pipe lines on board ship.

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BRONZOCHROM—Eutectic Welding Alloys Inc., New York. Welding and brazing rod for use where better wearing properties are desired, especially for guides, frictional surfaces, pistons, pumps, rods, bearings, etc. Welds can be polished to a very high gloss and have a low frictional coefficient.

See advertisement, Page 238

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BUFFALO Wire Cloth—Buffalo Wire Works Co. Inc., Buffalo, N. Y. Wire cloth for every industrial use; screens for abrasive material, chemicals and powder in plain steel, tinned, brass, copper, bronze, monel and stainless steel; also galvanized after woven wire cloth.

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BUNTING Bearing Bronzes—The Bunting Brass & Bronze Co., Toledo, O. Precision machined cored and solid bar stock. Over 1000 sizes of standardized fully-finished stock bearings for machinery applications. All cast in accordance with bearing bronze specification SAE 660 (QQB-691, Grade 12). Special sizes made to blueprint from SAE, AMS, ASTM, Federal Navy and Air Corps specifications and from our own recognized standard bronze bearing alloys, viz:

No. 72 (SAE 660); copper 83, tin 7, lead 7 and zinc 3. General-purpose bearing bronze, meeting conservation demands for copper and tin, and substituted for higher tin content alloys.

No. 27; copper 80, tin 10 and lead 10. General purpose bearing bronze.

No. 96; copper 87.5, tin 10 and lead 2.5. For severe service, heavy pressures.

No. 98; copper 88, tin 10 and zinc 2. Hard bronze, severe service, heavy pressures. An allowance of 1 per cent lead content improves machinability and bearing characteristics without impairing the physicals. Used in aviation engines.

No. 124; copper 85, tin 5, lead 9 and zinc 1. Excellent in automotive camshaft and piston pin applications.

No. 125; copper 75, tin 5 and lead 20. Good antifriction properties.

No. 164; copper 86, tin 11, lead 1.5 and nickel 1.5. Gears and synchronizer rings.

No. 178; copper 68, tin 4 and lead 28. Main and connecting rod applications.

No. 170; lead 75, tin 10 and antimony 15; babbitt metal.

No. 116; tin 86, copper 7 and antimony 7; genuine babbitt metal.

Aviation and machine tool bearings and transmissions cones are sand, chilled or centrifugally cast and machined to the utmost precision dimensions and surface finishes.

See advertisement, Page 220

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CARBOLOY—Carboloy Co. Inc., Detroit. A series of cemented carbides basically made from tungsten carbide and a softer cementing element such as cobalt. In certain grades, supplementary ingredients are the carbides of tantalum, titanium or other metals. Has high resistance to abrasive and corrosive wear; outstanding on account of its extreme hardness. compressive strength being as high as 800 000 lb. per sq. in.; tensile strength. 100-200,000 lb. per sq. in.; Rockwell hardness on "A" scale 86-93; does not rust or corrode under normal conditions. Recommended as wear resistant inserts for machine parts subject to extreme wear such as cams, cam followers, hydraulic valve stems, seats, machine tool rests, etc.

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CARPENTER—The Carpenter Steel Co., Reading, Pa.

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Stainless No. 1; carbon .1, chromium 13; furnished in finished rods or bars, coiled strips for turning, boring, forging, stamping and welding; corrosion-resistant; high tensile strength; for cold-headed parts, valve trim, turbine blades, pump shafts, heat-treated parts, etc.

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Stainless No. 2; carbon .3; chromium 13; used in fully hardened condition for ball bearings, ball check valves, balls, instruments, etc.

Stainless No. 2B; carbon 1, chromium 17; uses same as No. 2 used for hardened balls, valve seats, etc.

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Stainless No. 3; carbon .15, chromium 20, copper 1; for special chemical apparatus and scale resisting parts, stampings and moldings.

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Stainless No. 4; carbon .1, chromium 18, nickel 8; for rolled moldings, stampings, wire parts, tubing, etc.; also has high ductility.

Stainless No. 5; carbon .1, chromium 13.5, sulphur .30; a free-machining grade for automatic screw machine parts, valve trim, pump shafts, etc. Is heat-resistant.

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Stainless No. 6; carbon .1, chromium 17; uses same as No. 1 and No. 4—stampings, wire parts and moldings.

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Stainless No. 8; carbon .1, chromium 18, nickel 8, selenium .25 a free-machining grade; heat-resistant; screw machine work.

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Presto; carbon 1.05, chromium 1.4; for ball and roller bearings.

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Silico-manganese steel; carbon .6, manganese .75, silicon 2; for heavy-duty springs.

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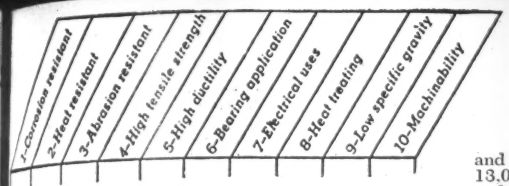
No. 5-317; chrome-nickel steel; carbon .5, nickel 1.75, chromium 1; for gears, clutches and shafts.

No. 5 Samson; carbon .5, nickel 1.25, chromium .6; for gears and clutches.



No. 4-408; carbon .4, nickel 3, chromium .75; for clutches and shafts.

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No. 158; carbon .1, nickel 3.5, chromium 1.5; for case-hardened high duty clash gears, shafts and clutch parts.

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No. 2 Samson; carbon .2, nickel 1.25, chromium .6; for case-hardened gears, roller bearings, pneumatic tool parts, etc.

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No. 4 Samson steel; carbon .4, nickel 1.25, chromium .6; for side links of silent chains, shafts, axles, etc.

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No. 3-547; nickel-steel; carbon .3, nickel 3.5; for heat-treated shafts, etc.

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No. 2-547; case-hardening nickel-steel; carbon .2, nickel 3.5; for small parts requiring hard surface and tough core.

No. 500; carbon .1, nickel 5; for turbine blades, case-hardened gears, etc.

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Chrome-vanadium 5-720; carbon 5, chromium .9, vanadium .2; for leaf and coil springs, gears, shafts, etc.

No. 3-427; chrome-molybdenum-steel; carbon .3, chromium 1, molybdenum .2; for aircraft and automotive parts.

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No. 436; carbon .15, nickel 1.75, molybdenum .25; for case-hardened parts.

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Temperature compensator alloy; iron-nickel alloy; furnished in rough bars or billets, finished rods or bars, wire and strips for hot forging, stamping, turning, boring, etc.; permeability varies inversely as temperature; for magnetic shunts for meters, speedometers, tachometers, voltage regulators, etc.

See advertisement, Pages 122-123

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CASTOLIN—Eutectic Welding Alloys Inc., New York. Low-temperature welding alloys, bind without melting base metal; high strength; matching color; less stresses; less warping; less preheating. Welds steel of all analyses, stainless, cast iron, malleable iron, cast steel, bronze brass, copper, aluminum and alloys, magnesium and alloys, nickel and alloys. Company also produces alloy welding rods, Castolin in Autochemic Flux.

See advertisement, Page 238

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CECOLLOY—Chambersburg Engineering Co., Chambersburg, Pa.

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A; carbon 3-3.2, molybdenum .12, nickel .15; shock resistance, vibration damping, close grain.

B; carbon 3-3.2, molybdenum .10, chromium .10; also has shock resistance, is vibration damping; has close grain in heavy sections.

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CECOLLOY IRON—Chambersburg Engineering Co., Chambersburg, Pa.; carbon 3, manganese .90 silicon 1.8-1.9, nickel .10, molybdenum .15; suitable for casting in cement-bonded sand molds; resists corrosion to atmospheric conditions and acids; has tensile strength of 56,000 lb. per sq. in.; brinell hardness of 200; for steam cylinder liners, cylinders, rings and valves; also beds for heavy-duty machine tools.

CERROBASE—Cerro de Pasco Copper Corp., New York. Bismuth-lead casting alloy which expands on cooling; melts at 255 degrees Fahr.; tensile strength 6100 lb. per sq. in.; recommended for master patterns, electroforming, engraving machine models, etc.

CERROBEND—Cerro de Pasco Copper Corp., New York. Bismuth-lead-tin-cadmium casting alloy which expands on cooling and has the extremely low melting temperature of 160 degrees Fahr.; tensile strength of 6000 lb. per sq. in.; useful as a fusible alloy and as a filler for tube bending.

CERROMATRIX—Cerro de Pasco Copper Corp., New York. Bismuth-lead-tin-antimony casting alloy which melts at 248 degrees Fahr. and expands on cooling; tensile strength 13,000 lb. per sq. in.; used for locating and anchoring machine parts in cored holes.

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CHACE—W. M. Chace Co., Detroit.

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Thermostatic bimetal; a number of combinations including alloys of nickel-iron, nickel-iron-chromium, nickel-iron-manganese, pure nickel, brass, bronze, etc.; responsive to various temperature ranges and provide a wide range of deflection rates and electrical resistivities; for temperature control elements in controllers, recorders, indicators, circuit breakers, etc.

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No. 772 manganese alloy; manganese 72, copper 18, and nickel 10; furnished in finished rods or bars, coiled strips and sheets; for turning, boring and stamping. Mechanical properties in untreated state: Ult. tensile strength, 120,000 lb. per sq. in.; yield point, 90,000 lb. per sq. in.; elongation, 12 per cent; impact resistance, high; brinell hardness, 200; specific gravity, .26 lb. per cu. in.; nonmagnetic; weldability, fair; heat-resistant to 500 degrees Fahr.; used where low thermal conductivity, high electrical resistivity and high thermal expansion are required.

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CHAMET BRONE—Chase Brass & Copper Co., Waterbury 91, Conn.

Type A; copper 60, tin .75, zinc 39.24; for shafting and structural and engineering uses.

Type B; copper 62, tin .65, zinc 37.35; for general cold heading and upsetting purposes.

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CHASE—Chase Brass & Copper Co., Waterbury 91, Conn.

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Cupro-Nickel; copper 70, nickel 30; largely used for condenser tubes particularly for extreme service in very corrosive waters.

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Leaded commercial bronze; copper 89, lead 2, zinc 9; for screw machine parts requiring good physical properties and high corrosion resistance.

Also various high and low brasses and bronzes in various forms to meet specific requirements for a variety of mechanical parts.

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CHASE TELLURIUM COPPER—Chase Brass & Copper Co., Waterbury 91, Conn. Copper 99.5, tellurium .5; furnished in finished rods or bars and tubing for hot forging, extruding, turning, boring, etc.; corrosion resistant; resists heat to 450 degrees Fahr.; medium abrasion resistance; tensile strength 32-55,000 lb. per sq. in.; medium ductility; brinell hardness, untreated 90; for electrical connections, parts for electric motors, switches, etc.

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CHROMALOID—American Nickeloid Co., Peru, Ill. Chromium bonded to nickel-bonded zinc, latter serving as rust proof, flexible and inexpensive white metal base. Available in variety of brilliant finishes and patterns, as sheets, flat strips and coiled strip for continuous feed automatic presses. Can be supplied with quickly removable, gum adhered paper covering permitting drawing and forming without marring pre-finish.

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CHROMAX—Driver-Harris Co., Harrison, N. J. A heat resisting alloy used for carburizing containers or furnace parts; nickel 35, chromium 19, and balance iron.

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CHROMEL—Hoskins Mfg. Co., Detroit.

Alloy 502; nickel 35, chromium 15, balance mainly iron; supplied as castings, or as rod, bars, and strips. For general heat-resistant applications and for mechanical and load-carrying members which are heated to 2000 degrees Fahr.

Alloy 670; chromium 25, nickel 12, balance mainly iron; supplied as castings or as rod, bars and strips; for high temperature applications where sulphur corrosion must be withstood.

Grade A; nickel 80, chromium 20, supplied as castings or as rod, bars, wire and strip; used for electric heating elements to 2100 degrees Fahr.

Grade C; nickel 60, chromium 16, balance mainly iron; used for electric heating elements to 1700 degrees Fahr.; also used for rheostatic purposes; supplied as castings, or as rods, bars and strip.

Grade D; nickel 35, chromium 15, balance mainly iron; used for heating elements to 1400 degrees Fahr.; available cast, or as wire, rod and strip.

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CHROMEWELD 4-6—Lincoln Electric Co., Cleveland. For the welding of steels commonly known as 5 per cent chromium steels. Annealed at 1550-1600 degrees Fahr.; cooled slowly and stress relieved at 1400 degrees Fahr. will have tensile strength of 80-90,000 lb. per sq. in.; yield point, 55-65,000 lb. per sq. in.; elong. in 2 in., 24-30 per cent; reduction in area 60-70 per cent; brinell hardness, 155-175.

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CIMET—Driver-Harris Co., Harrison, N. J. Nickel 10-12, chromium 26-28, and balance iron; castings for furnace parts in high sulphur atmospheres, and for acid resisting castings in pump impellers, piping, etc.

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CIRCLE L—Lebanon Steel Foundry, Lebanon, Pa. This tradename covers forty-three different types of alloys and Emergency Steels including the following:

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No. 1; manganese 1.40, carbon .35, with vanadium or molybdenum.

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No. 2; carbon .32, chromium .75, molybdenum .30, manganese 1.40; for crankshafts, airplane parts, valves and other castings.

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No. 3; carbon .40, chromium 1.25, vanadium .12, molybdenum .40, manganese .75, for gears and cams, and nitrided parts.

No. 5; carbon .30, chromium .75, nickel 1.75; molybdenum .30; for highly stressed parts.

No. 6; carbon .15, nickel 1.75, molybdenum .25; for cams, gears and other case-hardened parts (carburizing).

No. 9; carbon .25, molybdenum .45; for parts subject to temperature.

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No. 10; carbon .20, chromium 5.50, molybdenum .55; for high pressure and high temperature applications in the oil industry.

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No. 11; carbon .25, chromium 18; stainless steel; for parts subject to nitric acid corrosion.

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No. 12; carbon .10, chromium 13; stainless steel; for chemical apparatus, etc.

No. 13; carbon .25, chromium 13; for stainless steel parts where high hardness is essential.

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No. 15; carbon .30, chromium 27; heat and corrosion service.

No. 22; carbon .07 max., chromium 19.0, nickel 9; for miscellaneous stainless parts and castings to be polished. Also made with molybdenum and/or columbium as required.

No. 23; carbon .15, chromium 19.0, nickel 9; miscellaneous stainless alloy castings.

No. 30; carbon .15, chromium 24, nickel 12; for valves, pumps and miscellaneous parts for the paper industry.

No. 31; carbon .22, chromium 28, nickel 11; resists temperature to 2000 deg. Fahr.

No. 32; carbon .50, chromium 15, nickel 35; heat resisting castings requiring strength at elevated temperatures.

No. 34; carbon .06, chromium 20, nickel 30, molybdenum 3, plus copper.

See advertisement, Page 127

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CLETALOY—Cleveland Tungsten Inc., Cleveland. Copper-tungsten type electrode for spotwelding. Available in four grades with high specific gravity.

CT-A; predominantly tungsten; hardness of 92-97 Rockwell B with an electrical conductivity about 38 per cent that of pure copper. In addition to spot-welding, it works well as crimper die insert for finish turning edge of steel jacket to form a seal for the porcelain stem in spark plugs.

CT-65; conductivity and tungsten similar to that of CT-A grade; hardness of 84-91 Rockwell B. For welding of thin stainless steel sheets, and in the upsetting of special

1-Corrosion resistant | 2-Heat resistant | 3-Abrasion resistant | 4-High tensile strength | 5-High ductility | 6-Bearing application | 7-Electrical uses | 8-Heat treating | 9-Low specific gravity | 10-Machinability

steel which does not forge well, this grade supplies red hot surface which can withstand high pressure of small bar during knob-forming process. This grade holds original hardness especially well.

CT-86; has a higher electrical conductivity than other grades, with a Rockwell B hardness of 77-83; suitable for welding nonferrous metals and for applications where low pressures are sufficient.

LN-14; silver tungsten base alloy for use in applications where it shows an advantage over copper, possibly having some connection with the fact that silver oxide which might form on surface is a better electrical conductor than copper oxide.

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CLEVE-TUNG—Cleveland Tungsten Inc., Cleveland. Tungsten ground seal rod for power tubes, etc.

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CMP STRIP—The Cold Metal Products Co., Youngstown, O. Precision cold-rolled strip steel, carbon and alloy grades; in any gage .001-inch or heavier. All standard tempers and finishes.

See advertisement, Page 116

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COBALTCROM-PRK-33—Darwin & Milner Inc., Cleveland. Carbon 1.4, chromium 13, cobalt 3.3, manganese .3, silicon .6, molybdenum .6; in rough bars or billets and finished rods or bars; for hot forgings, turning, boring, etc. Mechanical properties in heat-treated state are ult. tensile strength, 200,000 lb. per sq. in.; compressive, 226,000; yield point, 70-80,000; impact resistance, low; hardness, to 63 Rockwell C; specific gravity, 10 per cent below that of tungsten high-speed steel; heat-resistant to 1500 degrees Fahr.; abrasion resistance, high; for valves in aeroplanes and tanks.

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COLDARC—Eutectic Welding Alloys Inc., New York. Welding rod for use with alternating and direct current, flux-coated, green with white tips. No flux required. An alloy binding on cast iron at low heat, complete without preheating, giving color matching and machinable welds. For chilled iron, meehanite, nickel iron, old cast iron, etc. or wherever a cold weld may be applied.

See advertisement, Page 238

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COLDWELD—Eutectic Welding Alloys Inc., New York. Cast-iron welding and brazing alloys and fluxes, binds on all ferrous and nonferrous metals except aluminum. Grayish in color. Size of rods, ¼ inch with yellow tips. For very delicate castings, and where temperature must be avoided as on water jackets, cylinders, compressors, crank and gear cases, etc.

See advertisement, Page 238

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COLMONOY—Wall-Colmonoy Corp., Detroit.

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No. 4; chromium-nickel-boron welding rod; hardness, C-40 Rockwell; nonmagnetic; weldability, good; resists corrosion caused by most chemicals; heat-resistant to 1800 degrees Fahr.; abrasion resistance, high; for valve seats, and other work requiring both high abrasion resistance and machinability.

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No. 5; nickel-chromium-boron welding rod; hardness, C-50 Rockwell; nonmagnetic; weldability, good; heat-resistant to 1750 degrees Fahr.; for pump sleeves, wear rings, and parts subject to combined corrosion and abrasion.

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No. 6; similar to No. 5; with hardness number of C-66 Rockwell; weldability, very good; heat resistant to 1700 degrees Fahr.; abrasion resistance, very high; for shaft sleeves, hot oil and pump parts, thrust collars, seal rings, bushings, cams, valve faces, gage anvils, plug gages, centers and centerless grinder blades.

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No. 9; chromium-molybdenum-boron-iron-silicon welding rod; anneals to Rockwell C-55 at 1550 degrees Fahr.; hardens back to C-64 at 1900 degrees Fahr. in high compressive strength; hardness number, C-65 Rockwell; magnetic; weldability, good; abrasion resistance, high; for many parts requiring combined resistance to wear and red hardness and toughness, such as reamers.

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No. 20; nickel-chromium-boron welding rod, fabricated into parts by sand casting, turning, boring, etc.; Rockwell hardness number, C-20; nonmagnetic; resists corrosion caused by most chemicals; heat resistant to 2000 degrees Fahr.; abrasion resistance, medium; for parts in chemical machines subject to corrosion.

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COLORSTRIP—Acme Steel Co., Chicago 8. Strip steel, electro-galvanized or plain and coated on one or both sides with any specific color (coating may be either enamel or lacquer); furnished in coils and can be fabricated by rolling or stamping; corrosion resistant; resists heat to 150 degrees Fahr.; same tensile strength, elongation and hardness as standard strip steel with slight variations depending on temper and analysis of the base metal.

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COLUMBIA—Columbia Steel & Shafting Co., Pittsburgh 30. Furnished in bars; tensile strength is high; bearing properties, good; material machines freely.

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COMMERCIAL—Buckeye Brass & Mfg. Co., Cleveland. Cored and solid bronze bars; copper 80, tin 10, lead 10; for bushings, bearings and bars.

See advertisement, Page 128

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COMPO—Bound Brook Oil-Less Bearing Co., Bound Brook, N. J. Oil-retaining porous bronze bearings and washers; copper 88.75, tin 9.75, graphite 1.5; porous structure containing as high as 35 per cent of oil or other lubricant by volume. Made to Army, Navy and Air Corps Specifications for gun mounts, airplane engines and chassis, machine tools, electric motors, automobiles, etc.

See advertisement, Page 246

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CONTINENTAL ALLOY STEELS—Continental Roll & Steel Foundry Co., East Chicago, Ind.

C-2; low and medium carbon, manganese-nickel-cast-steel for parts requiring high physical properties, for tractor frames, locomotive castings, power shovel castings, locomotive crane castings.

C-3; medium carbon, manganese-molybdenum-cast-steel for sprockets, spindles, gears, miscellaneous castings for power shovels, locomotive cranes, locomotive wheel centers and crossheads.

C-4; low-medium carbon, manganese-molybdenum-vanadium-cast-steel for pinions, axles and spindles.

C-5; medium carbon, nickel-molybdenum-cast-steel for forging hammer rams.

C-6; medium carbon, high chrome, vanadium cast steel for special abrasive and crusher requirements for sand mills, rock crushers, etc.

All the above are specially heat-treated to give high physical properties.

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CONTINENTAL SUPER STEEL — Continental Roll & Steel Foundry Co., East Chicago, Ind. Chrome-nickel-molybdenum rolling mill rolls for billet, blooming, merchant and bar mills.

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COOPER ALLOYS—The Cooper Alloy Foundry Co., Hillsdale, N. J. Numerous castings of stainless steel, monel, nickel, chrome-iron, chrome-nickel and other special alloys, for various applications.

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COPEL—Hoskins Mfg. Co., Detroit. Copper 55, nickel 45; used mostly for thermostatic and electrical resistance purposes, also for heating elements to 800 degrees Fahr. Temperature coefficient of resistance is practically nil.

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COPPERWELD—Copperweld Steel Co., Glassport, Pa. Copper-covered steel in steel wire or rod, with copper exterior permanently welded (cast) to the steel core; resists rust and corrosion; provides adequate electrical conductivity for many electrical uses and rust-resisting high strength for many mechanical uses. In its Warren, O. plant the company also produces aircraft steels, stainless steels, Nitralloy steels, bearing steel and carbon and alloy tool steels.

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CRAMP ALLOYS—Cramp Brass & Iron Foundries Division Baldwin Locomotive Works, Philadelphia.

No. 49; furnished in rough bars or billets, rods or bars, and sand castings; resists heat to 400 degrees Fahr.; high abrasion resistance; tensile strength 120,000 lb. per sq. in.; compressive, 55,000; medium ductility; specific gravity, 6.8; good bearing properties; used for heavy-duty, slow-moving loads.

No. 99; furnished in rough bars or billets and rods or bars; resists corrosion by sulphuric, sulphurous, acetic acids; heat-resistant to 450 degrees Fahr.; high abrasion resistance; tensile strength 55,000 lb. per sq. in.; compressive, 22,000; good bearing properties; brinell hardness, untreated 100; used for high-speed bearings and acid-resisting parts.

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CRASFLOY—Continental Roll & Steel Foundry Co., East Chicago, Ind. Hard alloy grain iron rolling mill rolls made in four grades: mild, medium, hard and super hard.

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CRO-MOL C-9 and C-10—Continental Roll & Steel Foundry Co., East Chicago, Ind. Chrome-molybdenum cast steel for hammer parts, etc.

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CUFERCO—Westinghouse Electric & Mfg. Co., East Pittsburgh. Copper-iron-cobalt alloy resembling Cupaloy, but has greater strength, higher heat resistivity, more mechanical endurance, and somewhat lower electrical conductivity.

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CUPALOY—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Copper base alloy containing chromium and silver; thermal and electrical conductivity 80-90 per cent pure copper; tensile properties of steel; brinell hardness of 140-160; applications include spot-welding tips, seam-welding wheels and rolls, mechanical parts carrying heavy current, etc. Licensee: A. W. Cadman Mfg. Co., Pittsburgh.

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CUPRON—Wilbur B. Driver Co., Newark, N. J. Copper 55, nickel 45; in rough bars or billets, finished rods or bars, wire and coiled strips. Mechanical properties in untreated state: ult. tensile strength, 62,000 lb. per sq. in.; percent elongation, hard 2—soft 40; specific gravity, 8.9; nonmagnetic; weldability, good; heat-resistant to 1500 degrees Fahr.; abrasion resistance, high; for electrical uses.

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D-H-S BRONZE—Koppers Co., Bartlett Hayward Div., Baltimore. In rough bars or billets, rods or bars, also as sand castings; zinc 21-25, copper 61-65, hardener (aluminum, manganese and iron) 13-15; resists corrosion, heat-resistant to 400 degrees Fahr.; high abrasion resistance; tensile strength, 100-130,000 lb. per sq. in.; compressive, 90,000; elastic limit, 40,000-65,000 lb. per sq. in.; elongation in 2 in., 20-11 per cent; specific gravity .278 lb. per sq. in.; nonmagnetic; brinell hardness, untreated 200-240; for heavy-duty bearings, gears, guides, screws, stems, nuts, etc.

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DAMASCITE—Chrysler Corp., Amplex Div., Detroit. A ferrous, nonporous high-density material used as parts and shapes; tensile strength, ult., 80,000 lb. per sq. in.; readily machined; heat-treatable; high magnetic properties.

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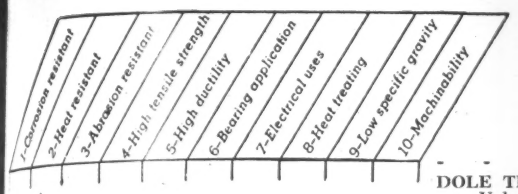
DEFENDER METAL—Magnolia Metal Co., Elizabeth, N. J. Lead-tin-antimony alloy furnished in ingots, as substitutes for tin-base babbitts. Mechanical properties in untreated state: ult. tensile strength, 16,000 lb. per sq. in.; yield point 7685; impact resistance, medium; hardness, 20 brinell.



resists corrosion caused by lubricating oils; abrasion resistance, medium; used for internal combustion engines, trap rock crushers and sifter machinery.

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DEFIHEAT—Rustless Iron & Steel Corp., Baltimore. No. 446 stainless type carbon .35 max., chromium 23 to 30; resists nitric and sulphuric acids, also heat to 2000 degrees Fahr.; for furnace parts and other applications involving high heat.

See advertisement, Page 131

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DEFIRUST—Rustless Iron & Steel Corp., Baltimore.

No. 410 stainless type; carbon .15 max., chromium 10-14; hardening type of stainless steel for turbine blades.

No. 416 machining type; carbon .15 max., sulphur .15 and chromium 12-14; hardening type of stainless steel possessing free-cutting properties.

See advertisement, Page 131

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DEFISTAIN—Rustless Iron & Steel Corp., Baltimore.

Types 302, 304 and 308; carbon .08-.12 max. or .08 max., manganese 2 max., chromium 18-22, nickel 8-12; retains high tensile strength and resistance to creep to 1300 degrees Fahr.; nonmagnetic; resists nitric acid, salt air, and food; resists heat to 1600 degrees Fahr.; recommended for machine parts which come in contact with food.

Type 303, machining; carbon .2 max., sulphur .15 min., chromium 18-20 and nickel 8-10; has high ductility and free-cutting properties; resists heat to 1550 degrees Fahr., and tensile strength to 200,000 lb. per sq. in.; recommended for same purposes as above where free cutting is desirable.

Rustless 18-12 Mo., types 316-317; carbon .09 max., chromium 16-20, nickel 14 max., molybdenum 2-4; corrosion-resistance; used for parts in paper and pulp, and chemical industries.

Columbium type 347; carbon .1 max., chromium 17-20, nickel 8-12; columbium ten times carbon; same properties as Defistain except welded equipment does not require annealing after welding material is stabilized.

See advertisement, Page 131

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DEWARD—Allegheny Ludlum Steel Corp., Brackenridge, Pa. Carbon .9, manganese 1.5, molybdenum .3; for holders for thread chasers and gang punches. Oil hardening.

See advertisement, Page 235

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DM-45—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O. Carbon .4-.5; manganese .4-.7, silicon .5-.8, chromium 1-1.5, molybdenum .45-.65; furnished in rough bars or billets, and finished rods or bars; for hot forging, turning, boring, etc., into parts. Resists heat to 1100 degrees Fahr.; tensile strength, 150,000 lb. per sq. in., min , heat treated; medium ductility; and brinell hardness, untreated 185, heat treated 411 max. For bolts, studs and other highly-stressed parts used at elevated temperatures.

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DM STEEL—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O. Carbon .15 max., manganese .3-.6, silicon .5-1, chrome 1-1.5, molybdenum .45-.65, phosphorus .03 max., sulphur .03 max.; furnished in rough bars or billets, finished rods or bars, and tubing, for hot forging, welding, turning, boring, etc. into parts. Resists heat to 1100 degrees Fahr., tensile strength, ult., 60,000 lb. per sq. in., min.; medium ductility fair weldability; and brinell hardness, annealed 163 max. Used for oil refinery field.

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DODGE Steel Castings—Dodge Steel Co., Tacony, Philadelphia. Electric steel castings, both carbon and alloy; used particularly for turbine, pump valve and pressure castings.

See advertisement, Page 124

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DOLE THERMOSTATIC BIMETAL—The Dole Valve Co., Chicago. In strips and fabricated elements; for stamping and coiling; good magnetic properties; good weldability; recommended heat treatments are 600-700 degrees Fahr.; free end of thermal element deflects proportionately with changes in temperature; used to provide protection against excessive temperature and temperature control at predetermined temperatures.

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DOLER-ALUMIN — Doehler Die Casting Co., New York. Aluminum base die castings. Composition suited to meet stringent requirements, as high tensile strength, impact strength, hardness, corrosion resistance, thermal conductivity and electrical conductivity.

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DOLER-BRASS—Doehler Die Casting Co., New York. Brass die castings. Composition suited to meet varying conditions. Tensile strength to 100,000 lb. per sq. in., and hardness to 180 brinell; excellent corrosion resisting properties.

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DOLER-MAG—Doehler Die Casting Co., New York. Magnesium base die castings made from the lightest of the commercial metals; one-third lighter than aluminum.

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DOLER-ZINK—Doehler Die Casting Co., New York. Zinc base die castings of maximum tensile and impact strength.

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DOWMETAL—The Dow Chemical Co., Midland, Mich. Magnesium alloy ingots, castings, wrought forms, rods, bars, sheet, shapes, extrusions, sand and die castings; also forgings, magnesium metal ingots and magnesium metal sticks. Available in various types:

C; aluminum 9, manganese .1, zinc 2, remainder magnesium; in ingots for sand casting; ult. tensile strength, 39,000 lb. per sq. in.; ult. compressive, 60,000; yield strength 16,000; elongation, 10 per cent; impact resistance, high; high elastic resilience; specific gravity 1.82; nonmagnetic; resists corrosion caused by caustic chromic acid, hydrofluoric atmospheres, etc.; used for reciprocating parts and housings.

FS-1; aluminum 3, manganese .3, zinc 1, remainder magnesium; in rough bars or billets, finished rods or bars, tubing, sheets, coiled strips, plates; for extruding, rolling, drawing and pressing; ult. tensile strength, 40,000 lb. per sq. in.; yield strength 29,000; compressive, 50,000; elongation, 16 per cent; endurance limit (completely reversed bending), 14,500 lb. per sq. in.; specific gravity, 1.77; nonmagnetic; high elastic resilience; used for aircraft parts and other applications requiring light weight.

H; aluminum 6, manganese .2, zinc 3, remainder magnesium, in ingots for sand casting; ult. tensile strength, 39,000 lb. per sq. in.; yield strength, 14,000; compressive, 39,000; elongation, 12 per cent; impact resistance, high; high elastic resilience; specific gravity, 1.83; resists corrosion caused by caustic, chromic acid, hydrofluoric atmospheres, etc.; used for aircraft parts and other applications requiring light weight.

J-1; aluminum 6.5, manganese .2 zinc 1, remainder magnesium; in rough bars or billets, finished rods or bars, tubing, sheets, coiled strips, plates; for hot forging, extruding, rolling, drawing and pressing; ult. tensile strength, 43.000 lb. per sq. in.; yield strength, 30,000; ult. compressive, 69,000; elongation, 17 per cent; endurance limit (completely reversed bending), 17,000 lb. per sq. in.; specific gravity, 1.8; nonmagnetic; high elastic resilience; for structural parts and fabricated housings.

M; manganese 1.5, remainder magnesium; in the same form as for sand casting, hot forging, rolling, drawing and pressing. Mechanical properties in rolled state: Ult. tensile strength, 37,000 lb. per sq. in.; yield strength, 27,000; elongation 10 per cent; impact resistance, high; specific gravity, 1.76; nonmagnetic; weldability, good; heat-resistant to 400 degrees Fahr.; high elastic resiliency; for parts requiring best formability of magnesium alloys.

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Mn; manganese 1.5, remainder magnesium; furnished in strips, sheets and plates; for pressing and drawing. Mechanical properties in untreated state: ult. tensile strength, 37.000 lb. per sq. in.; yield strength, 29,000; elongation, 10 per cent; endurance limit (completely reversed bending), 10,000; specific gravity, 1.76; resists corrosion caused by alkalies, chromic and hydrofluoric acids and certain organic compounds; abrasion resistance, medium; for reciprocating parts, and parts for portable and transportation equipment.

O-1; aluminum 8.5, manganese .2, zinc .5, remainder magnesium; in rough bars or billets, finished rods or bars and tubing; for hot forging and extruding. Mechanical properties in heat treated state: Ult. tensile strength, 50.000 lb. per sq. in.; yield strength, 34,000; ult. compressive, 75,000; elongation, 7 per cent; impact resistance, high; endurance limit (completely reversed bending), 18,000 lb. per sq. in.; specific gravity, 1.8; nonmagnetic; high elastic resiliency; for structural parts requiring maximum strength.

R; aluminum 9, manganese .2, zinc .6, remainder magnesium; in ingots for die casting. Mechanical properties in untreated state: Ult. tensile strength, 33 000 lb. per sq. in.; yield strength, 21,000; elongation 3 per cent; impact resistance, high; specific gravity, 1.74; abrasion resistance, medium; nonmagnetic; for housings and structural parts.

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DRIVER-HARRIS—Driver-Harris Co., Harrison, N. J.

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No. 42 alloy; notable for its coefficient of linear expansion—approximately that of different grades of glass.

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No. 52; alloy of nickel and iron has been successfully used for sealing in glass and in which process no coating is required prior to the operation.

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DUQUESNE SPECIAL—Continental Roll & Steel Foundry Co., East Chicago, Ind. Chrome-nickel-molybdenum steel for rolls subject to severe service, also for abrasive castings.

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DURALOY—Duraloy Co., Scottdale, Pa. High-chrome, iron and chrome-nickel alloys in a number of different grades with minor and major variations in analyses to meet a wide variety of requirements.

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DURASPUN—Duraloy Co., Scottdale, Pa., Centrifugal castings including tubing with a wide range in wall thicknesses, and odd shapes such as materials conveyor screws.

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DURCO—Duriron Co. Inc., Dayton, O. Alloy steels (KA2S, KA2SMo., etc); 18 chrome, 8 nickel, carbon max. .07, and other standard as well as special analyses preferred by users; for pumps, valves, fittings, castings for corrosive service, etc.

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DUREX—Moraine Products Div., General Motors Corp., Dayton, O. Products of powder metallurgy in iron, bronze and other metals; self-oiling bearings and various small parts for electric motors, instruments, airplanes, tanks, etc.

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DURFACE—Eutectic Welding Alloys Inc., New York. Wear-resistant surfacing alloy welding rods for gas and arc use on steel, manganese steel, cast-iron.

See advertisement, Page 238

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DURICHLOR—Duriron Co. Inc., Dayton, O. Silicon 14.5, molybdenum 4, carbon .80, traces of phosphorus and sulphur, balance iron; for pumps, valves, pipe, castings for corrosive service, especially for hydrochloric acid and chloride solutions.

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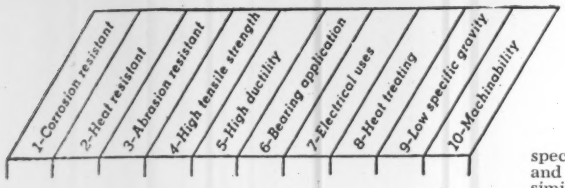
DURIMET—Duriron Co. Inc., Dayton, O. Nickel 22, chromium 19, silicon, molybdenum and copper 5 approx., carbon .07 max., balance iron; for pumps, valves, bolts, nuts and castings for corrosive service, especially



weak sulphuric acid.

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DURIRON—Duriron Co. Inc., Dayton, O., and licensees. Silicon 14.50, carbon .8, manganese .6, sulphur and phosphorus traces, balance iron; for pumps, valves, exhaust fans, mixing nozzles, and castings for handling acids and other corrosive liquids and gases.

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DURO-GLOSS—Jessop Steel Co., Washington, Pa. Stainless steels in following grades:

C-1, type 410; ult. strength, 70,000 lb. per sq. in.; yield point, 40,000; elongation in 2 inches, 35 per cent; used for automotive, chemical and electrical appliance equipment, gates and valves, etc.

C-2, type 430; ult. strength 80,000 lb. per sq. in., yield point 50,000; elongation in 2 inches, 35 per cent; brinell hardness, 163; used for chemical plant equipment, condensers, steam engine parts, pump shafts, fans, blowers, restaurant equipment, etc.

C-3, type 442; ult. strength 80,000 lb. per sq. in.; yield point 55,000; elongation in 2 inches, 35 per cent; brinell hardness, 171; used for same type of applications as C-4, but intended for use at slightly lower temperatures.

C-4, type 446; ult. strength 90,000 lb. per sq. in.; yield point, 55,000; elongation in 2 inches, 25 per cent; brinell hardness, 171; used for tubes, manifolds, linings, etc.

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DURONZE ALLOYS—Bridgeport Brass Co., Bridgeport, Conn. High copper-silicon bronzes alloyed with elements such as tin, iron, aluminum, etc.; possess high strength combined with corrosion resistance.

I; possesses excellent cold working properties; for making cold-headed bolts and screws, average 100,000 lb. per sq. in. tensile strength; in rod, wire and sheet form.

II; hot-rolled sheet for making range boilers, automatic heaters and storage tanks by either electric arc or oxyacetylene welding methods; cold-rolled strip used as a substitute for phosphor bronze spring metal; rod and wire used for making hot-headed bolts and screw products; supplied in sheet, rod, wire, and ingot forms.

III; supplied in rod form only; tensile strength from 85,000-100,000 lb. per sq. in.; hot forgings 90,000 lb. per sq. in.; free-machining for making screw machine parts, also for sucker rods for corrosive oil wells; ten per cent lighter than brass; excellent corrosion resistance; in ingot form may be used for making sand castings with tensile strength about 70,000 lb. per sq. in. Used for compression fittings for oil and gas lines in airplane construction, sliding parts for machine guns, small gears, screws, pinions, valve parts, etc.

IV; made into condenser tubes only; for resisting corrosion from aerated sea water mixed with fresh water and acid wastes, sewage, etc., often found in harbors.

V; wire for making difficult cold-headed parts, screws, bolts, rod, sheet and tubing for outdoor service; malleable; good corrosion resistance; tensile strength, about 100,000 lb. per sq. in. recommended for cold-headed bolts and outdoor use.

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DUTCH BOY BABBITT—National Lead Co., New York 6. Analysis of the material varies according to the bearing application.

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DYN-EL—Alan Wood Steel Co., Conshohocken, Pa. Furnished in sheets, strips, and plates, for stamping, welding, cold and hot forming, etc.; abrasion resistance, medium; tensile strength 70-80,000 lb. per sq. in.; ductility high; weldability good; fatigue and impact values high; for structures requiring high strength.

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EASY-FLO—Handy & Harman, New York 7. Brazing alloy; flows at 1175 degrees Fahr.; silver 50, copper 15.5, zinc 16.5, cadmium 18; resists corrosion due to silver content; specific gravity 9.49; for brazing ferrous and nonferrous metals, particularly dissimilar metals and monel metal, stainless steel and other copper-nickel and chrome-nickel alloys. Has many electrical uses. Also Easy-Flo No. 3 for fabrication of large copper piping, etc.

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ECLIPSE Seamless Flexible Metal Hose—Eclipse Aviation Div., Bendix Aviation Corp., Philadelphia. Bronze 85/15, with 3 per cent silicon, steel, aluminum, silver and various other alloys. Tubing resists corrosion caused by salt water, ammonia, steam, gases, etc., and heat up to various degrees Fahr. Has high ductility and can be used where flexible tubing is required.

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ECONOMO—Wheelock Lovejoy & Co., Inc., Cambridge, Mass. Carbon .2 and .5 with alloy of molybdenum; free machining; for machine tool parts.

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EIS 45—Heppenstall Co., Pittsburgh. Carbon .85 chrome 12. Furnished for hot forging into parts. Used for shear blades for shearing medium heavy material.

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EIS 57—Heppenstall Co., Pittsburgh. Nickel-chrome-molybdenum-steel, .6 carbon; for insert and hot die steel service.

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ELASTUF CHRO MOLY (Modified)—Horace T. Potts Co., Philadelphia.

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NE 9450—Heat-Treated; special chrome-nickel-molybdenum alloy steel of National Emergency type; heat-treated to high physical properties for uses requiring high tensile, fatigue and impact strength. Furnished in machinable condition.

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NE 9450—Hot-Rolled Annealed; furnished in readily machinable condition for parts requiring greater than machinable strength.

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ELASTUF PENN—Horace T. Potts Co., Philadelphia. Hot-rolled steel furnished in rough bars or billets, and finished rods or bars for hot forging, turning, boring, etc.; tensile strength 125,000 lb. per sq. in.; medium ductility. Used where maximum strength in a carbon machinery steel is required or where untreated alloys of simpler type have been used.

ELECTROMET — Electro Metallurgical Sales Corp., New York. A line of ferro-alloys and alloying elements of various analyses.

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ELECTRUNITE—Steel and Tubes Division, Republic Steel Corp., Cleveland 18. Electric-welded tubing in stainless, carbon, and various alloy steels. Square, rectangular, oval, or other shapes, in any size or gage where the periphery of the shape is not less than 2-1/32 inches or more than 16 inches. Used for general mechanical, aircraft, conduit, boiler, condenser, heat exchanger and other pressure applications.

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ELEPHANT BRAND Phosphor Bronze—The Phosphor Bronze Smelting Co., Philadelphia. Furnished in wire, sheets and rods.

Sheets in rolls, slit sheet metal, tinned both sides; in various gages and tempers covering a broad range of uses.

Wire in coils for springs, flat wire, in coils or lengths; tinned binding for armature work, binding wire (round), dead soft to any temper required, straightened (round), in lengths.

Rods in complete range of sizes from rounds .010-4¾ inches, hexagons ⅛-2⅜ inches, and squares .03-2¼ inches. Also in many rectangular and special shapes; for parts subject to corrosion, fatigue, wear, shock and abrasion.

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ELKALOY—P. R. Mallory & Co. Inc., Indianapolis. A work-hardened alloy of copper, not heat-treatable, for spot and seam welding aluminum and its alloys, unpickled hot-rolled steel, terne plate, tin plate, galvanized iron and other materials. A direct substitute for copper, it handles the same but is harder and lasts longer.

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ELKONITE—P. R. Mallory & Co. Inc., Indianapolis. Three definite classes of materials.

One group based on copper and such refractory metals as tungsten, molybdenum and their carbides—combinations which produce material with good electrical conductivity and great wear-resistant qualities, for use as welding electrodes and contactors in oil immersed circuit breakers. Certain of these grades are heat treatable. The heat treatment improves electrical and physical properties.

Second group based on silver and refractory material such as tungsten, molybdenum, and their carbides, and has been developed primarily as a facing material for heavy-duty electrical contacts and contactors for air breakers.

Third group comprises basically silver in which is incorporated refractory material such as cadmium oxide or nickel. These materials are used as heavy contacts, particularly for aircraft relays, and contact facings and main contacts on heavy-duty breakers.

All three groups can be used in the form of thin facings or as inserts with copper or copper alloy baking materials, having high electrical conductivity coupled with high physical properties.

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ELKONIUM—P. R. Mallory & Co. Inc., Indianapolis. A series of electrical contact materials divided into the following groups: Silver, platinum, palladium and gold-base alloys. These groups are designed to cover a wide range of applications and can be supplied in a wide variety of forms.

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ELVERITE—Babcock & Wilcox Co., New York. Sand-cast and chill-cast wear irons for tube mill liners, roll heads, jaw crushers and special applications.

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ENDURO—Alloy Steel Div., Republic Steel Corp., Massillon, O. Stainless and heat-resisting alloy.

Chromium-nickel group:

17-7; chromium 17, nickel 7, carbon .09-.2; used for automotive trim and for deep drawing where straight chromium types are not sufficiently ductile.

18-8; chromium 18, nickel 8, carbon cont. .08-.2; especially suited to resist atmospheric corrosion and corrosion reagents; for dairy and chemical plant equipment, food and meat processing machinery, high-strength, lightweight structural members, and for resistance to oxidation at elevated temperatures.

18-8-S; similar to 18-8 except carbon is kept under .08 which permits its use in welded equipment subject to severe corrosion.

18-8-FS; a special modification of 18-8 to develop greater softness and less work hardening; better adapted to successive drawing and spinning operations with less annealing than 18-8.

18-8-STi; 18-8-S to which titanium has been added for eliminating intergranular corrosion at high temperatures; used for airplane collector rings and exhaust manifolds, and other high temperature requirements.

18-8-SCb; 18-8-S plus columbium; for applications similar to those for which 18-8-STi is recommended. More efficient as carbide stabilizer and better corrosion resistance than titanium.

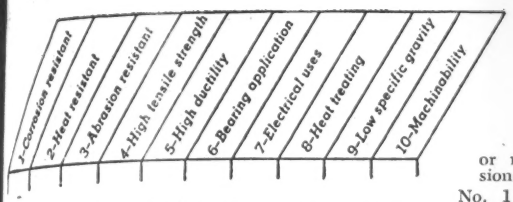
18-8-SMo; 18-8-S plus 1.75-2.5 molybdenum; resistant to acids encountered in paper and pulp processes, woolen dyeing and in chemical and pharmaceutical industries; recommended for severe corrosive conditions; good fabricating and welding properties.

18-8-B; 18-8 with 2 to 3 silicon; for resistance to oxidation in temperatures up to 1700 degrees Fahr.; for annealing boxes, furnace parts, etc.

18-8-FM; a free-machining type of 18-8 through addition of .07 min. selenium; machinability very good for chromium-nickel type—about 70 per cent that of screw stock. Corrosion resistance same or little less than 18-8.

HCN; chromium 25, nickel 12; for resistance to oxidation up to 2000 degrees Fahr.; fabricates, machines, and welds readily. High strength and creep at elevated temperatures. Not recommended for high sulphur conditions at high temperatures.

NC-3; chromium 25, nickel 20, silicon 1.5 max.;



for maximum heat resistance. Best strength and creep at high temperatures, but may be attacked if sulphur present in gases. Resistant to carburizing.

S-Turbine Quality; chromium 11.5-13, carbon .15 max. used for applications where corrosion resistance and physical strength are needed at medium high temperatures.

S-High Carbon; a straight chromium, high-carbon grade for heat treating for high hardness applications.

Straight chromium group:

S-1; chromium 11.5-13.5, carbon .15 max., responds readily to heat treatment and is recommended where strength, toughness and hardness are required; for pump shafts, valve seats and stems, nuts and bolts, etc.

S-1 Nickel; a modification of S-1 with addition of 1.25-2.5 nickel for somewhat better physical properties than S-1.

FC; free machining grade of S-1 analysis; still 12-14 chromium. Machines nearly as well as screw stock. Fairly resistant to the atmosphere, organic and fruit acids, etc. Can be hardened by heat treatment up to about 400 brinell. Considerably more care and control required in forging operation than with S-1.

AA; chromium 14-18, carbon .12 max.; good corrosion resistance; heat resistant to 1500 degrees Fahr.; fabricating and welding properties inferior to 18-8; for bicycle fenders, oil burner parts, etc.

AA High Carbon; a variation of AA with somewhat better physicals.

AA-FM; a free-machining codification of AA with machinability about 85-90 per cent of Bessemer screw stock.

HC; chromium 23-27; heat-resistant to 2000 degrees Fahr.; not affected by sulphur gases; strength and creep at high temperatures not as good as the chromium-nickels.

18-23; chromium 18-23; high heat resisting properties; good resistance to scaling, but strength and creep lower than chromium-nickel types; for furnace parts, etc.

4-6 per cent; chromium 4-6 with several carbon ranges to .25 and with or without addition of molybdenum or columbium, titanium, aluminum and tungsten; additions of columbium, titanium or aluminum practically eliminate air-hardening on welding; corrosion and heat resistance considerably superior to that of carbon steels, and with fair strength at high temperatures; for oil refinery and furnace parts.

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ERMAL—(Z-Metal)—Erie Malleable Iron Co., Erie, Pa. A spheroidized pearlitic-malleable iron; for castings requiring rigidity, high tensile strength, and abrasion resistance. Suitable for heat treatment.

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ERMALITE—Erie Malleable Iron Co., Erie, Pa. Wear-resisting alloy iron; for gears, wearing plates, friction drums and other parts subject to high stresses or wear.

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EVANSTEEL—Chicago Steel Foundry Co., Chicago. Nickel 1-1.5, chromium .65-1, carbon varies from .3-.5, sometimes carries additions of vanadium or molybdenum; for castings such as passenger car knuckles, tooth bases, sprockets, gears, high pressure valves, etc.

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EVERDUR—American Brass Co., Waterbury, Conn.

Alloy No. 1010; copper 95.8, silicon 3.1, manganese 1.1; uses include tanks and sewage disposal apparatus.

Alloy No. 1015; copper 98.25, silicon 1.5, manganese .25; easily fabricated by all methods including welding; used for tubes, bolts and screws.

Alloy No. 1000; casting alloy; copper 94.9, manganese 1.1, silicon 4.

See advertisements, Pages 147-153

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FACEWELD—Lincoln Electric Co., Cleveland. Coated-type electrodes for hard-facing worn parts of straight carbon, medium carbon or manganese steel to resist severe abrasion and moderate impact.

No. 1 (yellow tip); deposits of single layer have hardness of 45-52 Rockwell C. Multiple layers have hardness of 52-58 Rockwell C. Toughness of this deposit is greater than that of No. 12.

No. 12 (red tip); single layer hardness is 52-57 Rockwell C. Multiple layer hardness is 55-59 Rockwell C.

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FAHRALLOY—The Fahralloy Co., Harvey, Ill. High nickel-chrome, depending on analysis; furnished as castings; heat-resistant to 2100 degrees Fahr.; used for furnace parts, quenching fixtures, carburizing pots, etc.

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FAHRITE—The Ohio Steel Foundry Co., Springfield, Ohio.

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N-1; carbon .4-.6, chromium 15-18, nickel 34-38; in rods, bars and sand castings; resists oxidation to 2000 degrees Fahr.; has high strength and ability to withstand thermal shock at high temperatures; good weldability; ult. tensile strength, 70,000 lb. per sq. in.; specific gravity, 7.94; brinell hardness as cast 165-185; for trays, chain links, retorts and furnace parts.

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N-3; carbon .3-.5; nickel 10-13; chromium 24-27; in rods, bars, sand castings and centrifugal tubes; resists oxidation to 2000 degrees Fahr. and corrosive attack in sulphur atmosphere; as high strength at elevated temperatures; good weldability; ult. tensile strength, 90,000 lb. per sq. in. with 20 per cent elongation; specific gravity, 7.73; brinell hardness as cast 165-175; for tube supports, baffles, dampers, boxes, trays and retorts.

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N-61; carbon .4-.75, nickel 59-62, chromium 10-15; in sand castings; resists oxidation to 2000 degrees Fahr.; good weldability; ult. tensile strength, 70,000 lb. per sq. in.; specific gravity, 8.13; brinell hardness as cast 175-185; for carburizing furnace parts.

C-28; carbon .35 max., nickel 3 max., chromium 25-30; in sand castings; resists oxidation to 2100 degrees Fahr.; but has low high temperature strength; highly resistant to sulphur gas atmosphere; poor weldability; ult. tensile strength, 90,000 lb. per sq. in. with 18 per cent elongation; specific gravity, 7.6; brinell hardness, 150-200; for use where resistance to high temperature in sulphur gas atmosphere is required.

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FANSTEEL—Fansteel Metallurgical Corp., North Chicago, Ill.

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Molybdenum; molybdenum 99.9+; in finished rods or bars, wire, sheets, strips and powder metal; for stamping, turning, boring, welding into parts; ult. tensile strength, 260.000 lb. per sq. in.; impact resistance, high; brinell hardness, 147; specific gravity, 10.2; nonmagnetic; resists corrosion caused by most acids; heat-resistant to 3000 degrees Fahr. in protective atmospheres; abrasion resistance, medium; used for critical electrical parts.

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Tantalum; tantalum 99.9+; in finished rods or bars, tubing, wire, sheets and strips; for stamping, turning, boring, welding, etc.; ult. tensile strength, 42.000-178,000 lb. per sq. in.; impact resistance, medium; brinell hardness, 75-125; specific gravity, 16.6; nonmagnetic; weldability, good; for corrosion-resisting parts.

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Tungsten; tungsten 99.95 per cent; furnished in rough bars or billets, finished rods or bars, wire sheets, shapes, powder metal and ribbon; for forming, fabricating and powder metallurgy; mechanical properties in untreated state: tensile strength, 490,000 lb. per sq. in.; impact resistance, high; brinell hardness, 290; specific gravity, 19.3; magnetic; resists corrosion caused by most acids; abrasion resistance, high.

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FARRELL—Farrell-Cheek Steel Co., Sandusky, O. Hard-edge; furnished as sand castings; high abrasion resistance; high-tensile strength and ductility; brinell hardness, heat-treated 650-700 and higher; for crane wheels, cast tooth gears, rollers, sheaves, sprockets, traction wheels, etc.

Type 85; specially processed steel castings for resisting abrasion, and possessing high strength, toughness and rigidity; tensile strength, to 150,000 lb. per sq. in.; used for parts subject to shock, high stress, overload, wear and abrasion.

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FEDERAL BRONZES—Federal-Mogul Corp., Detroit.

F1; a gear bronze suitable for heavily loaded piston pin bushings, etc.

F2; lead bronze for average bushings application.

F3; used largely as backs for babbitt-lined bearings.

F5; widely used for babbitt-lined bearing backs and for bushings where service is not severe.

F8; good casting and machining qualities.

F11; for piston pin bushings and other low speed, heavily loaded applications.

F15; has 20 per cent lead and may be used safely under adverse lubrication conditions.

F-16; because of high lead content may be used where only occasional lubrication is possible.

F18; high lead alloy of good casting characteristics.

F20; a hard bronze used for gears and worm wheels where requirements are severe; also aluminum-bronze and special analysis bronzes.

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FERROWELD—Lincoln Electric Co., Cleveland. For arc welding cast iron. Has steel base to give solid weld on cast iron of greater tensile strength than the cast iron itself. Due to low current which can be used, hardening effect usually present along the line of fusion is materially reduced.

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FIRTHALOY—Firth-Sterling Steel Co., McKeesport, Pa. Highly developed form of sintered carbide adapted to wire drawing dies, extrusion dies and similar purposes.

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FIRTHITE—Firth-Sterling Steel Co., McKeesport, Pa. Hard metal composition of sintered carbides furnished in a number of grades to form wearing surfaces or the edges of cutting tools.

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FIVEPOINT DEEPHARD STEEL—Foote Bros. Gear & Machine Corp., Chicago. Low-carbon steel parts, regardless of SAE or NE type, manufactured by the company and hardened by its Five Point Deephard process which can be applied also to castings, forgings, bar or plate steel, and results in superior wearing qualities. Company also has special alloy steel of a nickel-moly-chrome analysis, used especially to improve cores where it is otherwise impossible to obtain core hardness over 300 brinell because of excessive bulk. Furnished complete only as gears, pinions, or machine parts.

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FLEETWELD—Lincoln Electric Co., Cleveland. Shielded arc electrode for welding mild steel.

Type 5; for flat, vertical and overhead welding. Tensile strength, 65-75,000 lb. per sq. in.; ductility, 20 to 30 elong. in 2 in.; impact resistance, 30-70 ft. lbs. (Izod); density 7.84-7.86 grams per c.c.; corrosion resistance greater than mild steel.

Type 7; for general purpose welding and where fit-up is not of the best; low spatter and slag loss, high burn-off rate. Physical properties as welded; tensile strength, 70-80 000 lb. per sq. in.; yield point, 55-66,000; ductility, approximately 17 per cent elong. in 2 in.; specific gravity, 7.80.

Type 9; heavily coated electrode of shielded arc type specifically for flat welding of deep groove joints. Physical properties as welded; tensile strength, 66-74.000 lb. per sq. in.; yield point, 55-60,000; elong. 20-30 per cent in 2 in.; specific gravity, 7.85-7.86; operates either with d.c. or a.c.

Type 9-HT; heavily coated electrode of shielded arc type for deep-groove welding in a flat position of high tensile steels.

Type 10; for downhand welding on flat surfaces for finish bead welding and to provide full slag coverage and smoothness. Can be used with either direct or alternating current normal or reverse polarity.

Type 11; heavily coated electrode of shielded arc type for downhand fillet welding with "Fleet-Fillet" technique. Physical properties similar to Type 9.

1-Corrosion resistant | 2-Heat resistant | 3-Abrasion resistant | 4-High tensile strength | 5-High ductility | 6-Bearing application | 7-Electrical uses | 8-Heat treating | 9-Low specific gravity | 10-Machinability

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FLYLIGHT—Magnesium Div., Howard Foundry Co., Chicago.

Grade No. 8; aluminum 5.3-6.7, manganese .15 min., zinc 2.5-3.5, silicon .3 max., copper .05 max., nickel .01 max., others .3, magnesium remainder. As cast; for castings requiring moderate strength and toughness. Heat-treated; for castings requiring high strength and maximum toughness. Heat-treated and aged; for casting requiring high yield strength and hardness and moderate toughness.

Grade No. 4; aluminum 8.3-9.7, manganese .1 min., zinc 1.7-2.3, silicon .3 max., copper .05 max., nickel .01 max., others .3, magnesium remainder. Characteristics similar to Flylight No. 8. Flylight No. 4 is preferred for maximum pressure tightness.

See advertisement, Page 223

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FRANKITE—Frank Foundries Corp., Moline, Ill.,

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E-212; low-carbon electric furnace iron; pressure-resistant and long-wearing dense grain in heavy sections; for hydraulic bodies, refrigerator parts, compressor cylinders, etc. Good machinability.

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E-450; nickel 14, chromium 2, copper 6, electric furnace Ni-Resist. Has corrosion resistance, heat resistance to 1500 degrees Fahr.; fair machinability.

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E-604; nickel 4½, chromium 1½, electric furnace Ni-Hard white iron. Combats corrosion; for mixer blades, ash chutes, scrapers, grinding burs, etc.; machinability by grinding.

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E-830-N; chromium 30, nickel 3, low carbon; heat-resistant; for continuous oven kilns, cement kiln cooler parts, furnace supports, etc.; machinability, fair.

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FRONTIER—Frontier Bronze Corp., Niagara Falls, N. Y. Available in following grades:

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40 E; in sand castings and ingot form; not heat-treated; tensile strength, 30-38,000 lb. per sq. in.; yield strength, 22-26,000; elongation, 3-10 per cent; resists salt water corrosion; abrasion resistance, high; excellent machinability; resistant to hydrostatic pressure; resistance to shock and impact, high.

No. 5 aluminum bronze; in castings; tensile strength, 60-95,000 lb. per sq. in.; compressive, 22-65,000; ductility, good; brinell hardness, untreated, 130; heat-treated, 130-200; for parts where resistance to shock, fatigue and wear are essential.

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No. 11 nickel bronze; good bearing qualities with positive lubrication; wear-resistant; heat-treated, tensile strength, 60-70,000 lb. per sq. in.; yield strength, 38-45,000; elongation, 15-20 per cent; brinell, 160.

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No. 40E; furnished in rough bars or billets, and sand castings; ult. tensile strength, 32,000-38,000 lb. per sq. in.; yield point 22,000-26,000 lb. per sq. in.; elongation, 3-10 per cent; impact resistance, high; brinell hardness, 60-70; nonmagnetic; specific gravity, 2.81; resists corrosion caused by salt water; weldability, good; heat-resistant to 300 degrees Fahr.

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G ALLOY—American Smelting & Refining Co., New York. Lead-bearing alloy furnished in ingots for spinning and mold casting. Resists heat up to 300 degrees Fahr.; abrasion resistance, high; tensile strength, ult., 10,000 lb. per sq. in.; compressive 15,000; good bearing properties; brinell hardness, untreated, 22. Used for bearing applications. Is being widely substituted for tin babbitts.

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GIBSILOY—Gibson Electric Co., Pittsburgh. Electrical contacts having low contact resistance, nonsticking properties, long life under arcing conditions.

A; silver-nickel; A-1 silver 95, nickel 5, to A-8 silver 60, nickel 40; in contact rivets, disks, screws and other shapes and in sheets and wire. Lowest contact resistance; highly ductile.

C; silver-graphite: C-1 silver 99, graphite 1, to C-7 silver 93, graphite 7; in contact disks and other shapes and in sheets. Best nonsticking properties.

NW; silver-nickel-tungsten; various combinations in contact disks and other shapes and in sheets. Hard, arc resisting.

See advertisement, Page 236

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GLOBE STAINLESS STEEL—Globe Steel Tubes Co., Milwaukee. Seamless steel tubing in common steels as well as most grades of SAE alloys, and stainless or corrosion-resisting steel.

See advertisement, Page 232

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GLYCO BABBITT—Joseph T. Ryerson & Son, Inc., Chicago. General tradename covering a group of specially processed lead base alloys including:

Turbo-Glyco; for high-speed, heavy-duty; average brinell hardness, 30.

Marine Glyco; for electric motor and marine work; average brinell hardness 27.

Standard Glyco; free flowing, general purpose; average brinell hardness 24.

Heavy pressure mill Glyco; high resistance to crushing loads; average brinell hardness 23.

Transmission Glyco; for line shafting and transmission work; average brinell hardness, 22.

See advertisement, Page 236

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GRAMIX—United States Graphite Co., Saginaw, Mich. Porous metal bearings and mechanical shapes, made in several grades of which the following is typical:

No. 81 sintered bronze; tensile strength, 10,000 lb. per sq. in.; compressive force to cause .001-inch permanent set, 8000 lb. per sq. in.; apparent density, 6.4-6.6 grams per cu. cm.; oil absorption (by volume), 20-30 per cent; coefficient of thermal expansion 70-200 degrees Fahr., .00000934 inches per inch per degree Fahr.

No. 86 sintered iron; tensile strength, 20,000 lb. per sq. in.; compressive force to cause .001-inch permanent set, 16,000 lb. per sq. in.; apparent density, 5.8-6.1 grams per cu. cm.; oil absorption (by volume), 15-20 per cent; coefficient of thermal expansion, 70-200 degrees Fahr., .0000071 inches per inch per degree Fahr.

See advertisement, Page 156

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GRAPH-M.N.S.—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O. Carbon 1.5; manganese, 1.25; phosphorus .025, max., sulphur .025, max., silicon 1, nickel 1.75, molybdenum .5, chromium .5; in hot-rolled bars and billets, finished rods and bars, wire, sheets, strip and plates. Has good resistance to abrasion, and nonscuffing properties when cold forming metal; tensile strength, annealed, ult. 135,000 lb. per sq. in., medium ductility, recommended heat treatment, heat to 1550-1650 degrees Fahr. depending on section; air cool. Brinell hardness, annealed 241, heat-treated 682. Used for various types of machine parts, as well as cold-working dies and tools.

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GRAPH-MO—Timken Steel & Tube Div. The Timken Roller Bearing Co., Canton, O. Carbon 1.5, silicon .8, manganese .4 max., phosphorus and sulphur .025 max., molybdenum .25; in hot-rolled bars or billets, finished rods or bars, seamless tubing, wire, strips, sheets and plates. Has high abrasion resistance; tensile strength, ult., 85,000 lb. per sq. in., min.; medium ductility; fair bearing properties; good weldability; good nonscuffing properties; recommended heat treatments for annealing, nor. 1600 degrees Fahr.; furnace cool from 1450, oil quench at 1475-1550 degrees Fahr.; brinell hardness, annealed 197, heat-treated 745. Used for various machine parts, as well as for cold metalworking tools and dies.

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GRAPH-SIL—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O. Carbon 1.5, silicon .9-1, manganese .4 max., phosphorus and sulphur .025 max.; in hot-rolled bars or billets, finished rods or bars, seamless tubing, wire, sheets, strips and plates. Tensile strength ult., 97,000 lb. per sq. in., min.; abrasion resistance, high; medium ductility; excellent machining and nonscuffing properties; good weldability; for annealing, nor. 1600 degrees Fahr., furnace cool from 1380 degrees Fahr.; brinell, 197; quench 1450-1525 degrees Fahr. into water brine. For use as cylinder liners and machine parts, as well as tools and dies.

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GUNITE—Gunite Foundries Corp., Rockford, Ill. Processed high-test cast iron in ten grades, with Gunite A as standard metal described here. Mechanical properties in untreated state: ult. tensile strength. 50,000 lb. per sq. in.; compressive, 120,000; impact resistance, medium; hardness, 207-241 brinell; weight density, .265 lb. per cu. in.; heat resistant to 1100 degrees Fahr.; abrasion resistance, medium; used for brake drums, hydraulic parts, crank shafts etc.

H

HANDY FLUX—Handy & Harman, New York. For brazing steel, stainless steel, monel metal, nickel, copper, beryllium-copper, brass, bronze, aluminum-bronze and various other ferrous and nonferrous metals and alloys. Liquid and active at 1100 degrees Fahr.

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HARDTEM—Heppenstall Co., Pittsburgh. Carbon .5, chrome-molybdenum-vanadium die steel; for die blocks, shafting, etc.

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HARDWELD—Lincoln Electric Co., Cleveland. High-carbon arc welding electrode having brinell of 225-488; provides dense, tough surface of moderate hardness to enable various steel parts to resist shock and abrasion; for locomotive or crane tire flanges, etc.

Type 50; medium-carbon steel electrode for building up steel parts and surfaces. Deposit has considerable resistance to deformation and wear, and is machinable at slow speed. Coating stabilizes the arc and permits deposition of a tough, dense medium carbon steel. Hardness, deposited on straight-carbon steel and allowed to cool naturally, 20 to 35 Rockwell C.

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HARDY POWDERS—Charles Hardy Inc., New York. Powder metals of various kinds including aluminum, brass, iron, manganese, nickel, tungsten, etc., compressed into parts; give most physical characteristics which are available from metal ore alloys produced by melting and casting. According to metal powders chosen, low or high Brinell hardness can be secured. Depending also on powders chosen, all above properties can be obtained.

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HASCROME—Haynes Stellite Co., Kokomo, Ind. Chromium-manganese-iron composition welding rod for hard-facing parts subject to abrasion and impact, and castings to resist abrasion and impact.

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HASTELLOY—Haynes Stellite Co., Kokomo, Ind. Corrosion-resistant, nickel-base alloys for piping, tanks, pump parts, valves, vessels.

A and B; nickel, molybdenum and iron; for resistance to hydrochloric acid.

C; nickel, molybdenum, chromium and iron; for resistance to wet chlorine, and oxidizing or reducing acid solutions.

D; nickel and silicon; for resistance to sulphuric acid, hot or cold.

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HAYSTELLITE—Haynes Stellite Co., Kokomo, Ind. Cast tungsten carbide; inserts, tube rod, and composite rod (welding) for hard-facing oil-well drilling tools, dredge cutter blades, etc.

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HEPPENSTALL—Heppenstall Co., Pittsburgh.

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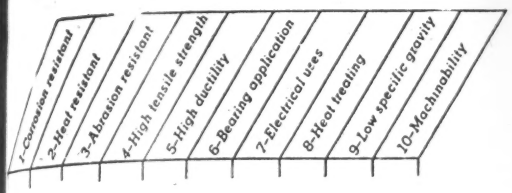
2 C 30; nickel-chrome-molybdenum steel; carbon .3, for shafting where high torsional strength is required such as drop hammer



piston rods.

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5 H 50; carbon .5, chrome-molybdenum and vanadium alloy; furnished as die blocks. Material is heat-resistant, abrasion-resistant; has high tensile strength and high ductility. Used for strip mill rolls, etc.

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HERCULOY—Revere Copper and Brass Inc., New York 17.

419 and 421; silicon 1.5-2.25, either .25 tin or .35 manganese, balance copper; in rods or bars, tubing, wire sheets, strips (coiled) and plates; for hot forging, stamping, extruding, welding, deep drawing and cold forging; corrosion-resistant; medium abrasion resistant; tensile strength, ult., 45-90,000 lb. per sq. in.; high ductility; for cold-headed bolts, nuts, screws, nails and electrical hardware.

418 and 420; silicon 3, either .5 tin or 1 manganese, balance copper; same as above; tensile strength, ult., 55-120,000 lb. per sq. in.; high ductility; used for range boilers, and for applications requiring high strength in combination with good weldability and corrosion resistance of copper.

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HI-GLOSS—Jessop Steel Co., Washington, Pa.

Type 304; stainless steel having ult. strength of 90.000 lb. per sq. in.; yield point, 45,000; elongation in 2 in., 60 per cent; weight per cu. in., .238 lb.; brinell hardness, 150; used for pumps, airplanes, air conditioning, automotive, chemical, dairy and restaurant equipment, etc.

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HILLS-McCANNA—Hills-McCanna Co., Chicago.

Magnesium alloy sand castings; light in weight; has high strength; and is used for aircraft parts, etc.

See advertisement, Page 144

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HIPERNIK—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

A magnetic alloy consisting of 49.5 per cent nickel and 49.5 iron; manganese .1; extremely ductile; developed for special magnetic properties at moderately low induction, primarily for radio applications; also used for transformer laminations; melting point is 1450 degrees Cent.; used for relays, radio and current transformers and instrument parts.

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HITEST—The Medart Co., St. Louis.

Cast iron for ordinary cast-iron uses and for cast steel in some applications. Material is corrosion-resistant; has high tensile strength; and good machinability.

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HOYT BABBITT METAL—National Lead Co., New York 6.

Analysis of material varies according to the bearing application.

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HUBBARD SPECIAL—Continental Roll & Steel Foundry Co., East Chicago, Ind.

Nickel-chrome steel for applications such as wear-resisting rolls, guides and other miscellaneous castings.

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HY-SPEED—Buckeye Brass & Mfg. Co., Cleveland.

Copper 88, tin 10, lead 2; for bushings, bearings, bars.

See advertisement, Page 129

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HYTEMCO—Driver-Harris Co., Harrison, N. J.

Alloy of nickel and iron characterized chiefly by its high temperature coefficient of electrical resistance; lends itself advantageously to uses requiring self regulation by temperature such as immersion heaters, etc.

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HY-TEN—Wheelock-Lovejoy & Co. Inc., Cambridge, Mass.

Chrome-manganese-molybdenum and chrome-nickel-molybdenum alloys with carbon from .10-1; machinability, good; for machine parts.

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IDEALOY—Wellman Bronze & Aluminum Co., Cleveland.

Copper-tin-zinc alloy for heavy-duty bearings.

See advertisement, Page 233

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ILLIUM—Burgess Parr Co., Freeport, Ill.

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G; nickel 54-58, chromium 20-24, copper 5-7, molybdenum 5-7, iron 5-7, manganese .75-1.5, silicon .65, max., carbon .2 max.; brinell hardness 160-210; tensile strength, 60-73,000 lb. per sq. in.; for pumps, meters, chemical equipment and other parts subject to corrosion; resists most corrosive solutions in a wide range of temperatures and concentrations including the halogens in dry state and their salts and acids in low concentrations at ordinary temperatures; resists heat to 1500 degrees Fahr.

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R; nickel 54-58, chromium 20-24, copper 0-4, molybdenum 5-7, iron 5-7, manganese .75-1.5, silicon .65 max., carbon .1 max.; brinell hardness 175-240 (annealed) 340-365 (work hardened); tensile strength 95-105,000 lb. per sq. in. (annealed) and 140-150,000 (work hardened); for pumps, meters, chemical equipment and other parts subject to corrosion; resists most corrosive solutions in a wide range of temperatures and concentrations including the halogens in dry state and their salts and acids in low concentrations at ordinary temperatures; resists heat to 1500 degrees Fahr.

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INCONEL—The International Nickel Co. Inc., New York.

Nickel 79.5, iron 6.5, copper .2, manganese .25, silicon .25, carbon .08, chromium 13, sulphur .015; corrosion resistant, high mechanical properties, resistant to heat to 2000 degrees Fahr.; used for high temperature applications and equipment for handling food and chemical products.

See advertisements , Pages 121, 216

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INDIUM—The Indium Corp. of America, New York.

A very soft metal used electrolytically or as a constituent of nonferrous alloys; commercial grade 99 per cent pure, electrolytic grade, 99.99 per cent pure; furnished in finished rods or bars; recommended heat treatment, diffusion for 2 hours at 350 degrees Fahr.; specific gravity, 7.31; resists corrosion caused by salt spray and acids in oil; abrasion resistance, high; used for bearing surfaces, protective coating for moving parts subject to wear and corrosion, etc.

See advertisement, Page 238

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INGACLAD—Ingersoll Steel & Disc Div., Borg-Warner Corp., Chicago.

Stainless clad steel consisting of a layer of 18-8 chrome-nickel, Type 304, also 18.8 columbium stabilized and 18-8 molybdenum bearing, stainless layer bonded to a layer of ordinary steel; uses include equipment for chemical, food, dairy, processing, brewery, packing house, bottling industries, etc.; suitable for applications requiring stainless steel protection on one surface.

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INGERSOLL—Ingersoll Steel & Disc Div., Borg-Warner Corp., Chicago.

Stainless steel in sheets for stamping and welding into parts; resists heat up to 1200 degrees Fahr.; abrasion resistance, medium; tensile strength, ult., 85,000 lb. per sq. in.; ductility, high; brinell hardness, annealed, 165.

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INTERNATIONAL NICKEL — International Nickel Co. Inc., New York.

Nickel: nickel 99.4, copper .1, iron .15, manganese .2, silicon .05, carbon .1, sulphur .005; rustproof, corrosion-resistant chemical parts.

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L Nickel; a low carbon type of nickel, otherwise similar in chemical composition to nickel. Especially suitable in contact with fused caustic and certain fused salts; corrosion and heat resistant.

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D Nickel; nickel 95.2, copper .05, iron .15, manganese 4.5, silicon .05, carbon .1, sulphur .005, a metal similar to nickel but affording superior mechanical properties and resistance to atmospheric attack at elevated temperatures; corrosion and heat resistant; for electrical uses.

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Z Nickel; nickel 98; heat-treatable material resembling nickel except for its higher mechanical properties which are comparable to those of oil-tempered spring steel; corrosion resistant; used for products requiring spring properties coupled with corrosion resistance.

See advertisements, Pages, 121, 216

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IRALITE—Mackintosh-Hemphill Co., Pittsburgh.

Carbon 2.8-3.5, plain and alloyed cast iron; nickel, molybdenum and chromium as required. Furnished as castings; ult. tensile strength 40,000-75,000 lb. per sq. in.; brinell hardness, 175-400; magnetic; resists corrosion caused by acids; heat-resistant to 1500 degrees Fahr.; abrasion resistance, high; for lathe and engine beds, etc.

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J & L CORRECT BALANCE (Forging Steel)—Jones & Laughlin Steel Corp., Pittsburgh.

Furnished in rough bars or billets, finished rods or bars, and plates, for hot forging. Tensile strength, compressive strength, ductility, weldability, and heat treatments are as specified. Used for any carbon steel parts made from forgings.

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JSB—Johnson Bronze Co., New Castle, Pa.

Bronze on steel in finished bearings; medium abrasion resistance; bearing properties, good; used for bushings, bearings, washers, etc. Also babbitt on steel and babbitt on bronze bearings, bronze bearings and bushings, bronze castings.

See advertisement, Page 215

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JALCASE—Jones & Laughlin Steel Corp., Pittsburgh.

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Low-carbon open-hearth steel which offers machinability practically equivalent to Bessemer screw stock plus the added advantage of rapid case carburizing properties; manufactured as S.A.E. X1314 and S.A.E. X1315 in .10 to .20 carbon grades.

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Open-hearth steel which in the higher carbon ranges offers exceptional heat treating qualities combined with forging properties and good machinability; manufactured as S.A.E. X1330 (.25-.35 carbon), S.A.E. X1335 (.30-.40 carbon) and S.A.E. X1340 (.35-.45 carbon).

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JESSOP—Jessop Steel Co., Washington, Pa.

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Nonmagnetic steel; in rough bars or billets, finished rods or bars; sheets and plates; medium abrasion resistance; tensile strength, 80-110,000 lb. per sq. in.; medium ductility; specific gravity, 8.02; fair bearing properties; good weldability; brinell hardness, untreated 180, annealed, 150; used for transformer covers, controller covers, switch covers, spacing bars, end fingers, etc.

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Heat-resisting steels, in No. 4, 5 and 5-B grades; No. 4 has ult. strength 95,000 lb. per sq. in., yield point 50,000 lb. per sq. in.; used for castings, marine, submarine and torpedo parts, oil engine valves, pump shafts, etc. No. 5 has ult. strength of 100,000 lb. per sq. in.; yield point, 45,400; used for pump parts, etc. No. 5-B applications are similar to No. 5, but No. 5-B has superior resistance to corrosion, and is more easy to fabricate. No. 5-B is similar in physical properties to No. 5 except that its tensile strength is greater.

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Stainless-clad steel in any desired analysis and all degrees of cladding from 3-50 per cent; furnished as sheets or plates for stamping and welding into parts; corrosion resistant; high abrasion resistance; tensile strength, average, 63,000 lb. per sq. in.; high ductility and good weldability; used for heads, tank wells, lids and any part in which corrosion resistance is important.

1-Corrosion resistant | 2-Heat resistant | 3-Abrasion resistant | 4-High tensile strength | 5-High ductility | 6-Bearing application | 7-Electrical uses | 8-Heat treating | 9-Low specific gravity | 10-Machinability

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JOHNSON—Johnson Bronze Co., New Castle, Pa.
No. 27; copper 80, tin 10, lead 10; deoxidized with phosphorus; general purpose bearing bronze.

No. 19; copper 70, tin 11, lead 19; high wear rating and resistance to pounding for mill bearings, gas and diesel engines, excavating and pulverizing machinery, etc.

No. 25 (plastic bronze); copper 75, tin 5, lead 19, nickel 1; for high speed with light to medium loads and generally free from shock; because it has good acid resistance it is particularly suitable for pump bearings and sleeves, and also for electric motor, conveyor and fan, and woodworking machinery bearings.

No. 29; copper 78, tin 7, lead 15; for use where spindle is of soft steel and speed is relatively high; acid-resisting alloy.

No. 53; copper 88, tin 10, zinc 2; for severe service or heavy pressures; should be used where shaft is hardened steel and well lubricated.

No. 72; copper 83, tin 7, lead 7, zinc 3; best suited for moderate speeds and low loads.

No. 10 (babbitt alloy); tin 90, antimony 5, copper 5; for thin linings and also may be used in die castings.

No. 11; tin 87, antimony 7, copper 6; rather hard babbitt recommended as lining for connecting rods and shaft bearings subjected to heavy pressures.

No. 12; tin 90, antimony 7.5, copper 2.5; for high speeds and high temperatures.

No. LX; lead 74.75, antimony 15, tin 10, copper .25; for camshaft bearings.

See advertisement, Page 215

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K-42-B—Westinghouse Electric & Mfg. Co., East Pittsburgh. Nickel 46, cobalt 20, iron 12, chromium 18.75, titanium 2.25 furnished in rough bars or billets, rods or bars, wire, strips (coiled), and plates; for hot forging, stamping, turning, boring, welding, etc., also as sand casting; resists corrosion caused by atmosphere and salt solutions; resists heat to 1200 degrees Cent.; tensile, strength, ult., 127,100 lb. per sq. in.; nonmagnetic; brinell hardness, heat-treated 280; for applications where high strength at high temperatures is required.

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KENNAMETAL—Kennametal Inc., Latrobe, Pa.
Type KM; cobalt 11, tungsten-titanium carbide (W Ti C_2); tungsten carbide WC; columbium carbide constituting balance; for wear parts, etc.; resists heat to 1200 degrees Fahr.; high abrasive resistance; compressive strength about 650,000 lb. per sq. in.; transverse rupture strength 305,000 lb. per sq. in.; hardness, 90.8 Rockwell A (77.6 Rockwell C), thermal conductivity, .113 cal/sec/degrees Cent./cm; volume electrical conductivity, 4.7 per cent of annealed copper standard; thermal expansion about 6 × 10^{-6}/degrees C: Sp. G. 11.8, Young's modulus about 74,000,000.

Type KH; cobalt 10 per cent, tungsten-titanium carbide (W Ti C_2), and other ingredients, harder than type KM; used for valve balls and brinell balls; compressive strength about 670,000 lb. per sq. in.; transverse rupture strength, 275,000 lb. per sq. in.; hardness, 91.3 Rockwell A, (78.6 C); thermal conductivity .074 cal/sec/degrees Cent./cm.; volume electrical conductivity 3.7 per cent of copper; thermal expansion about 5.5 × 10^{-6}/degrees Cent.; Sp. G. 11; Young's Modulus, 70,200,000.

Type K3H; similar in composition to other types but harder; compressive strength, 675,000 lb. per sq. in.; transverse rupture strength, 260,000 lb. per sq. in.; hardness, 91.8 Rockwell A, (79.6 C); thermal conductivity, .068 cal/sec/degrees Cent./cm.; volume electrical conductivity, 3.3 per cent of copper; thermal expansion about 5.5 × 10^{-6}/degrees Cent.; Sp. G. 11.0; Young's Modulus, 72,100,000.

Type K4H; cobalt 7 per cent, tungsten-titanium carbide (W Ti C_2), and other ingredients; the hardest type of Kennametal. Has higher thermal conductivity than others; used for precision boring of steel, machining steel, semi-steel, brass, bronze, aluminum, etc.; compressive strength about 680,000 lb. per sq. in.; transverse rupture strength 225,000 lb. per sq. in.; hardness, 92.3 Rockwell A (80.6 C); thermal conductivity, .12 cal/sec/degrees Cent./cm.; volume electrical conductivity 5.3 per cent of copper; thermal expansion about 5.5 × 10^{-6}/degrees Cent.; Sp. G. 12.45;Young's Modulus 79,600,000.

See advertisement, Page 226

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KLEENKUT—Heppenstall Co., Pittsburgh, Tool steel containing 2 carbon and 12 per cent chromium; for shear knives for cold shearing light material.

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KONAL—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Nickel 72, cobalt 17, titanium 2.2, iron 6.25; internal combustion engine valves, molds and machine parts which are subject to stress at high temperatures.

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KOVAR—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Low expansion to 400 degrees Cent.; approximately 28 nickel, 17 cobalt, balance iron; for gastight metal-to-glass seals on radio tubes instrument parts, electronic tubes and all other glass-to-metal seals. Distributed by Stupakoff Laboratories, Pittsburgh.

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LEDALOYL—Johnson Bronze Co., New Castle, Pa. Self-lubricating bearing bronze, pre-alloyed; contains lead which eliminates harshness and provides conformability for misalignment; combination of lead and graphite plus oil content make it useful where lubrication is remote or likely to be forgotten.

See advertisement, Page 215

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LIGHTWELD—Lincoln Electric Co., Cleveland. Arc-welding electrode made for fabrication of chain and gear guards and other machine parts of light gage steel.

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LO CRO—Crucible Steel Co. of America, New York.
Type 501; stainless steel containing over .1 carbon, and 4-6 chrome.

Type 502; stainless steel containing .1 max. carbon, and 4-6 chrome.

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LOTUS BABBITT—Lumen Bearing Co., Buffalo 12. Lead base bearing babbitt.

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LUBRICO—Buckeye Brass & Mfg. Co., Cleveland. Copper 75, lead 20, tin 5 per cent; for bearings, bushings and bars.

See advertisement, Page 129

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LUKENS—Lukens Steel Co., Coatesville, Pa.
2 per cent nickel steel; in plates and spun and pressed heads; for hot forging, stamping, welding, riveting, turning, boring, etc., into many types of machine parts where a high-tensile steel of good ductility is required.

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Carbon-molybdenum steel; in plates and spun and pressed heads for hot forging, stamping, welding, riveting, turning, boring, etc.; for machine parts requiring a high-strength steel which retains its strength under conditions of elevated temperature operation.

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Abrasion-resisting steel; furnished same as above, for use in a variety of parts requiring resistance to wear or abrasion.

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Gear rim steel; furnished same as above; abrasion and wear-resisting; originally developed for use in rims of welded gear blanks, as well as other machine parts.

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Chrome-manganese steel; furnished same as above; tensile strength 100,000 lb. per sq. in.; used principally in fan blades and fan rings.

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3½ per cent nickel steel; furnished same as above; tensile strength 70,000 lb. per sq. in.; used where good resistance to impact is desired in parts operating in sub-zero temperatures.

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Manganese-vanadium steel; furnished in same as foregoing; high-tensile steel with good welding properties, used in construction of antiaircraft gun mounts and carriages as well as military tank parts.

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Manganese steel—titanium treated; furnished in same as foregoing; high tensile steel with good welding properties, used military and naval construction.

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Manganese-molybdenum steel; furnished same as foregoing; tensile strength 95,000 lb. per sq. in.; for use in parts in which abrasion and high tensile strength is desirable.

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Nickel-clad, Super nickel-clad, Inconel-clad and Monel-clad steels are all clad metals or bi-metals consisting of light layer of corrosion-resistant super-nickel, nickel, Inconel or Monel bonded to a heavier base plate of steel. All ore corrosion resistant and are used in variety of machine parts where this property is desirable.

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LUMEN ALLOYS—Lumen Bearing Co., Buffalo 12. (Note: "Lumen Alloy," together with each of the following numbers and grades, is a copyrighted term which should be used in specifying these materials. Thus, "Lumen Alloy No. OOA," etc.)

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Nos. 00A and 00C; high tin bronzes for high compression bearing applications.

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No. 1; zinc bronze for pressure castings including spur and bevel gears.

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No. 2; zinc bronze for machine parts, bearings, etc.

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No. 3; zinc bronze for mine service and paper mill machinery and bearings.

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No. 4; phosphor bronze (leaded), for bearings.

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No. 4 chill cast; for heavy-duty bearings, etc.
No. 4A; high-phosphorus bronze (leaded), for bearings on hard steel.

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No. 5; general service casting alloy; red brass; for low pressure valve bodies, etc.

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No. 7; phosphor bronze; uses include trolley wheels and castings to be nickel or chromium plated.

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No. 9; manganese bronze for machine parts requiring strength, electrical conductivity, and high pressure.

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No. 11-C; (sand cast) aluminum bronze; for miter, bevel gears and bearings subject to impact.

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No. 11-C; (heat treated) tensile strength 65-100,000 lb. per sq. in.; recommended where strength, corrosion and heat resistance are required.

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No. 14; zinc bronze, babbitt backing; for valve bodies, etc.

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No. 15; phosphor bronze; for worm wheels, bearings, etc.
No. 15 chill cast; for worm gears, nuts and bearings.

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No. 15A; phosphor bronze (slightly leaded); for worm wheels, bearings, etc.
No. 15A; chill cast; for heavy-duty bearings and worm gear castings.

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No. 20; super-manganese bronze; for machine parts requiring extra strength.

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No. 27; (sand cast) aluminum bronze; for strength and corrosion resistance.

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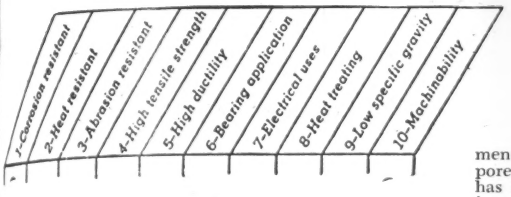
No. 27; (heat treated) for extreme tensile strength and shock resistance.



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No. 31; for high-speed, low-duty bearings.
No. 33; for bearings, high-speed, low-duty.

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No. 43; nickel-tin-bronze alloy for bearings, gears and nuts; abrasion-resistant.
No. 43 (chilled); nickel tin bronze for bearings, worm gears and nuts with higher tensile strength than No. 43.

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No. 48; nickel-phosphor-bronze; for bearings used with hardened steel, worm wheels, etc.

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No. 48 chill cast; for bearings, worm gears, nuts, slippers, etc.

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No. 54; phosphor bronze (leaded) for bearings and worm wheels for intermediate service.
No. 54 chill cast; for bearings, worm gears, nuts etc.

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No. 96; aluminum bronze, approximately 88 per cent copper, 8.5 aluminum and 3.5 iron; ult., tensile strength, 73,000 lb. per sq. in.; yield point, 25 000 lb. per sq. in.; hardness, 114-121 brinell; specific gravity, 7.7; and has medium abrasion resistance.

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Old Genuine Babbitt; high-strength ingot babbitt for bearings.

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Cosmos Babbitt; ingot materials for bearings.

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Bronze; a zinc base alloy for bearings.

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LYNITE—Aluminum Co. of America, Pittsburgh. Aluminum forged and cast products including pistons.

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MCA—Climax Molybdenum Co., Pittsburgh.
Ferro-Boron; alloying material in irons and steels. In castings use has been greatly augmented, giving increased strength and machinability, and in the case of malleable iron, ease of annealing.
Molybdenum; alloying element for use in steel and iron; imparts strength, toughness, ductility and resistance to abrasion; improves fatigue value, eliminates temper embrittlement, increases physical properties at elevated temperatures; molybdenum steel is easily welded and machined.
See advertisement, Page 142

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MD METAL POWDERS—Metals Disintegrating Co. Inc., Elizabeth, N. J. Alloy, antimony, aluminum (grain), bismuth, brass, bronze, cadmium, chromium, copper, iron, lead, manganese, molybdenum, nickel, silicon, silver, solder, tin, titanium, tungsten and zinc metal powders, having properties such as elimination of machining, compositions impossible to obtain by conventional methods, high surface area, catalytic work, etc.

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MRCO METAL POWDER—Metals Refining Co., Hammond, Ind. Metal powders furnished in the following grades:
40 RL; copper 99.4; all passing in a 40-mesh sieve, not over 20 per cent passing a 200 mesh screen; has apparent density of 2.5 grams per cu. cm.; used in commutator brushes, chemical porous filters, catalyzers, and pressed metal compositions.
100 RXA; copper 99.4; all passing a 100-mesh screen; not over 45 per cent passing a 325-mesh screen; has apparent density of 2.7 grams per cu. cm.; used in porous metal bearings, intricate pressed metal shapes, electrical commutator brushes, etc.
150 RXA; copper 99.4; all passing a 150-mesh sieve, not over 75 per cent passing a 325 mesh sieve; has apparent density of 2.7 grams per cu. cm.; for same applications as 100 RXA.
200 RL; copper 99.4; all passing a 200 mesh sieve, and not less than 85 per cent passing a 325 mesh sieve; used in chemical equipment, special commutator brushes, small pores in porous bearing compositions; also has advantages for copper brazing and coating welding rods.
500 RL; copper 99.4; all passing a 325 mesh sieve, and substantially all particles are less than 15 microns in dia.; for use where extremely fine particle size is desired, in brazing and coating, also as clutch facings, etc.
100 A; iron 96; all passing a 100-mesh sieve, not over 40 per cent passing a 325 mesh sieve; has apparent density of about 1.8-2.0 grams per cu. cm.; for pressed parts such as gears, filters, catalyzers, pressed ferrous metal compositions; electromagnets, etc.
100 B; iron 96 min., all passing a 100-mesh sieve, and 50 to 70 per cent passing a 325-mesh sieve; has apparent density of 2.3 to 2.5 grams per cu. cm.; used for the same purpose as 100A iron.
F; lead 99.7; all passing a 200-mesh sieve and substantially all particles less than 20 microns in dia.; used for same applications as 100 B.

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M-13—Precision Castings Co. Inc., Syracuse, N. Y. Aluminum 9, manganese .13, zinc .6, silicon .5 max., with magnesium base; die castings; ult. tensile strength, 33,000-34,000 lb. per sq. in.; yield point, 21,000 lb. per sq. in.; elongation, 2 to 5 (3 av.) per cent in 1 or 2 inches; impact resistance, low; brinell hardness, 60; specific gravity, 1.81; nonmagnetic; corrosion resistance, fair; heat-resistant to 700 degrees Fahr.; abrasion resistance, medium.

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MACHEMPITE—Mackintosh-Hemphill Co., Pittsburgh. Carbon .3-1.25, manganese 1.25-.175, molybdenum .25-.75; castings; ult. tensile strength, 85,000-125,000 lb. per sq. in.; yield point 65,000-100,000 lb. per sq. in.; elongation, 25/5 per cent; impact resistance, low; brinell hardness, 215-400; magnetic; weldability, good; abrasion resistance, medium; for gears, pinions, cams, rams, etc.

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MACHINEBRONZE—Lumen Bearings Co., Buffalo 12. Zinc bronze; cored and solid bars for bearings.

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MAGNOLIA—Magnolia Metal Co., Elizabeth, N. J.
Antifriction metal; lead-tin-antimony plus special fluxes, furnished in ingots; tensile strength, ult. 15,000 lb. per sq. in.; compressive, 20,650; bearing properties, good; brinell hardness, untreated 21.8; used for bearings.
Isotropic die cast bronze bar stock; copper 80, tin 10, lead 10, and other alloys to suit conditions; furnished in cored bars; resists corrosion caused by acids; resists heat to 900 degrees Fahr.; tensile strength, ult., 31,500 lb. per sq. in.; compressive 26,000; bearing properties, good; brinell hardness, untreated 70; used for bearings.

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MALLIX—National Malleable & Steel Castings Co., Cleveland. Pearlitic malleable iron; for grate bars for sintering machines, elevator buckets, screen plates for pan mills and other castings subjected to heat, abrasion and shock.

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MALLORY—P. R. Mallory & Co. Inc., Indianapolis.

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3 Metal; a copper-chromium-lithium alloy; used extensiveiy for spot, flash and seam welding cold-rolled steel, stainless steel, nickel alloys and Monel metal, silicon bronze alloys, zinc, nickel, silver and other materials employed in applications where a high-strength, high-conductivity material is required; available in rods, bars, strips and castings.

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53B Metal; copper base alloy furnished in castings and forgings only; tensile strength 60-70,000 lb. per sq. in.; used for heavy-duty butt seam welding wheels, flash welding dies, bearings and current and heat-carrying members in electrical and other machinery.
73 Metal; rough and finished bars, sheets, castings and forgings; containing 95 per cent copper; resists sea water; 110-170,000 lb. per sq. in. tensile strength; used for bearings and bushings, vibrator arms, springs, spring washers and electrodes for projection welding.
100 Metal; rough and finished bars, castings and forgings, containing 95 per cent copper; recommended for high loaded small gears, current-carrying bearings, springs and other details.
1000 Metal; predominantly tungsten; furnished in finished parts or blanks; ult. tensile strength, 100 000 lb. per sq. in.; impact resistance, medium; hardness, 32-40 Rockwell C; specific gravity, 16.9-17.1; nonmagnetic; heat resistant up to 300 degrees Cent.; abrasion resistance, high; for small counter weights, gyroscope rings, etc.

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MANGANWELD—Lincoln Electric Co., Cleveland. Arc welding electrode that produces deposit of austenitic manganese-nickel-molybdenum steel; suitable for hard facing austenitic manganese steel parts containing 11-14 per cent manganese, such as crusher parts, valves, turbine runners, pulverizer roll shafts, gathering and loading equipment.

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MAX-EL—Crucible Steel Co. of America, New York.
1-B; carbon .20, with high manganese and low molybdenum; excellent machining and uniformity in carburizing response; used for automobile parts, machine tool parts, gages, sprockets, etc.
2-B; carbon .35-.45, and otherwise identical in analysis to 1-B; used in "as rolled" condition for machine tool spindles, lead screws, racks, worms, piston rods, etc.
3½; for heat-treated parts on machine tools, such as gears, arbors, spindles, etc.

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MAYARI—Bethlehem Steel Co., Bethlehem, Pa.
A; a nickel-chromium series of steels, corresponding to S.A.E. 31XX series, suitable for heat-treated parts. Furnished in various carbon ranges for carburizing, water and oil-hardened parts.
B; a nickel-chromium steel furnished as bolts and sucker rods, having good atmospheric corrosion resistance combined with moderate strength, used in heat-treated condition.
R; a low-carbon, high-strength nickel-chromium-copper-phosphorus structural steel having good resistance to atmospheric corrosion. Used for structural purposes where weight reduction and corrosion resistance are desired.

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MAZLO Magnesium Alloys—American Magnesium Corp., Cleveland. Available in sand, permanent mold and die castings, rolled sheet, extruded bar, shapes and structural sections, and forgings.

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AM260; aluminum 9, zinc 1, manganese .2, magnesium remainder. Heat-treatable alloy for sand and permanent mold castings. For moving parts on high-speed production equipment and wherever pressure tightness and good strength are needed. Improved salt water resistance.
AM265; aluminum 6, zinc 3, manganese .2, magnesium remainder. Used for high-strength sand castings with good chemical stability.

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AM230; aluminum 10, silicon .7, manganese .2, magnesium remainder. Used for pressure die castings for parts requiring light weight and thin sections.
AM263; aluminum 9, zinc .6, manganese .2, magnesium remainder. Used for pressure die castings for lightweight parts in portable or fast-moving equipment.

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AM-C57S; aluminum 6, zinc 1, manganese .15, magnesium remainder. Used for extruded bars, tubes and rolled sheet for lightweight applications in general.
AM3S; manganese 1.5, magnesium remainder. Used for sheet, strip, extruded shapes, sand castings, and hammer forgings of moderate strength for uses requiring maximum salt water resistance. Suitable for fabricated articles such as aircraft oil tanks and cowlings.
AM-C52S; aluminum 3, zinc 1, manganese .2, magnesium remainder: Used for rolled sheet and extrusions of light weight. Good welding and forming characteristics and salt water resistance.
AM58S; aluminum 8, zinc .8, manganese .15.

1-Corrosion resistant | 2-Heat resistant | 3-Abrasion resistant | 4-High tensile strength | 5-High ductility | 6-Bearing application | 7-Electrical uses | 8-Heat treating | 9-Low specific gravity | 10-Machinability

magnesium remainder. Used for hot press forgings for parts under stress especially for aircraft and aircraft engine applications.

AM65S, aluminum 3.5, tin 5, manganese .5, magnesium remainder. Used for hot press forgings of moderate strength and lightness.

See advertisement, Page 118

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MCGILL—McGill Mfg. Co., Valparaiso, Ind.

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No. 1 McGill Metal; aluminum-bronze alloy, suitable for pump liners, gears, corrosion-resistant castings and parts requiring strength, toughness with minimum weight.

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No. 2; McGill silicon-bronze; corrosion-resistant; resists heat to 500 degrees Fahr.; medium abrasion resistance; tensile strength 95,000; brinell, untreated, 160-180.

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No. 4 McGill bronze hydraulic pressure castings; finished casting tolerance of ±.005.

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MEEHANITE—Meehanite Metal Corp., New Rochelle, N. Y., and licensees as listed hereunder. A sorbo-pearlitic iron containing silicon, manganese, phosphorus, sulphur and carbon, composition depending upon mixture and physical constitution as determined by service requirements; twenty-five grades, some of which can be heat treated, and flame hardened, each having a separate and distinct combination of physical properties; available in cast form; for machinery and miscellaneous castings.

Licensees include the following: American Brake Shoe & Fdy. Co., Mahwah, N. J.; Atlas Foundry Co., Detroit; Banner Iron Works, St. Louis; Barnett Foundry & Machine Co., Irvington, N. J.; E. W. Bliss Co., Brooklyn; H. W. Butterworth & Sons Co., Bethayeres, Pa.; Continental Gin Co., Birmingham Ala.; M. H. Detrick Co., Newark, N. J.; The Elliott Co., Jeanette, Pa.; Farrel Birmingham Co., Ansonia, Conn.; Otis Fenson Elevator Co., Hamilton, Ont.; E. Long Ltd., Orillia, Ont.; General Electric Co., Ontario, Calif.; Valley Iron Works Inc., St. Paul; Greenlee Foundry Co., Chicago; American Laundry Machinery Co., Rochester, N. Y.; Cincinnati Milling Machine Co., Cincinnati; Cincinnati Grinders Inc., Cincinnati; Cooper Bessemer Corp., Grove City, Pa., and Mt. Vernon, O.; Crawford & Doherty Foundry Co., Portland, Oreg.; Florence Pipe Foundry & Machine Co., Florence, N. J.; The Newark Stove Co., Newark, O.; Fulton Foundry & Machine Co. Inc., Cleveland; General Foundry Mfg. Co., Flint, Mich.; Stearns-Roger Mfg. Co., Denver, Colo.; Hamilton Foundry & Machine Co., Hamilton, O.; Kanawha Mfg. Co., Charleston, W. Va.; Kinney Iron Works, Los Angeles; Koehring Co., Milwaukee; Henry Perkins Co., Bridgewater, Mass.; Pohlman Foundry Co., Buffalo, N. Y.; Rosedale Foundry & Machine Co., Pittsburgh; Warren Foundry & Pipe Corp., Philipsburg, N. J.; Vulcan Foundry Co., Oakland, Calif.; Ross-Meehan Foundries, Chattanooga, Tenn.; Traylor Engrg. Co., Allentown, Pa.; Vancouver Engrg. Works, Vancouver, B. C.; Washington Iron Works, Seattle; Washington Machinery & Supply Co., Spokane, Wash.

See advertisement, Page 253

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METALINE—R. W. Rhoades Metaline Co. Inc., Long Island City, N. Y. Lubricating insert plugs of several diameters and lengths and in varied compositions for rendering bronze bearings and bushings oilless. Also bronze bearings complete in which Metaline plugs are inserted, furnished as finished bearings.

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MICHIGAN Seamless — Michigan Seamless Tube Co., South Lyon, Mich. Seamless tubing for forming and welding into parts for engines and other types of machines.

See advertisement, Page 241

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MIN-OX—The Binney Castings Co., Toledo 7, O. Heat-resistant castings for molds, valves, plungers, neck rings and other necessary mold parts for production of glass. Also known as Binney Metal.

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MOGUL BABBITT—Federal-Mogul Corp., Detroit.

Mogul alloy genuine babbitt; made from tin, antimony and copper, virtually lead free; hard, tough alloy; high tensile strength; suitable for die-cast and hand-poured bearings; used for high-speed automobile and aircraft engine, steel and bronze back main and connecting-rod bearings trucks, tractors, high-speed machinery, planers, etc.

Mogul bearing metal; general all-purpose babbitt for repair and maintenance; for bearings requiring toughness; used for machinery bearings, stationary gas engines, paper mill, rolling mill, rubber plant and brick machinery.

407 nickel babbitt; varying slightly from Mogul genuine babbitt alloy; for applications where speed is fairly high and bearings are large, that is 1/16th-inch or more in thickness; used in woodworking machinery and other heavy-duty types.

408 special babbitt (copper-hardened); originally produced for electric railway armatures, now used for special bearing applications; has great durability and will stand up under hard wear; used in motor pumps, motor shafts, rock crushers, forming presses.

Duro antifriction metal; while softer and less tough than Mogul bearing metal (above), compares favorably with lead base general purpose babbitts; used for flour mill, laundry, canning and bottling machinery, pump packing, slow-moving pulleys and axle bearings.

Special "B"; a lead and antimony alloy; free of usual nonbearing ingredients; used for slow-speed bearings and heavy line shafting.

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MO-LYB-DEN-UM—Climax Molybdenum Co., New York 18. An alloying element for use in steel and iron; imparts strength, toughness, ductility and resistance to abrasion; improves fatigue value, eliminates temper embrittlement, increases physical properties at elevated temperatures; molybdenum steel is easily welded and machined.

See advertisement, Page 142

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MO-MANG—American Manganese Steel Div., The American Brake Shoe & Foundry Co., Chicago Heights, Ill. Manganese 12-14, carbon .7-.9, with molybdenum; welding-rod for manganese steel and other ferrous castings.

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MO-MAX—The Cleveland Twist Drill Co., Cleveland 14. A high-speed steel, in rough bars or billets, finished rods or bars, wire and sheets, for hot forging, turning, boring, welding, etc.; resists heat to 1100 degrees Fahr.; high abrasion resistance; high tensile strength; good bearing properties; specific gravity about 7.95; good weldability; brinell hardness, untreated 220, heat treated 700; for use where great strength and wear resistance up to temperatures of 1000 degrees Fahr. are required such as gears, cams, guides, wearing plates, etc. Licensees are: Allegheny Ludlum Steel Co., Atlas Steels Ltd. (Canada), Bethlehem Steel Co., Braeburn Alloy Steel Corp., Carpenter Steel Co., Crucible Steel Co. of America, Henry Disston & Sons Inc., Halcomb Steel Div., Crucible Steel Co. of America, Jessop Steel Co., Latrobe Electric Steel Co., Universal-Cyclops Steel Corp., Vulcan Crucible Steel Co., Simonds Saw & Steel Co., and Columbia Tool Steel Co.

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MONEL—The International Nickel Co. Inc., New York. Nickel 67, copper 30, iron 1.4, manganese 1, silicon .1, carbon .15, sulphur .01; general purpose corrosion-resistance, high-strength, rust proof alloy; used for applications requiring protection against chemical reaction, high mechanical properties and attractive appearance.

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K Monel; nickel 66, copper 29, iron .9, manganese .85, silicon .5, carbon .15, sulphur .005, aluminum 2.75; heat-treatable alloy affording corrosion and abrasion resistance plus mechanical properties comparable to those of heat-treated alloy steels; nonmagnetic; for parts requiring corrosion resistance, high mechanical or nonmagnetic properties.

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KR Monel; chemical composition, resistance to corrosion, mechanical, magnetic and heat-treating properties same as those of K Monel; high ductility; has improved machinability. Available only in rod and wire forms.

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R Monel; nickel 67, copper 30, iron 1.7, manganese 1.1, silicon .05, carbon .1, sulphur .035; for parts requiring corrosion and abrasion resistance combined with free-cutting qualities permitting high-speed automatic machine work.

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S Monel; nickel 63, copper 30, iron 2, manganese .9, silicon 4, carbon .1, sulphur .015; high-strength, corrosion and abrasion-resistant material for castings requiring extra hardness for resistance of galling and seizing.

See advertisements, Pages, 121, 216

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MORAINE—Moraine Products Div., General Motors Corp., Dayton, O. Rolled bronze split-type bearings and bushings for automobiles, electric motors and farm implements.

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MORGANITE—Morganite Brush Co. Inc., Long Island City. N. Y. Carbon-graphite, and carbon-graphite-metal mixtures; in finished rods or bars and plates, for turning, boring, molding, etc.; resists corrosion caused by any liquid handled industrially; resists heat to 700 degrees Fahr.; good abrasion resistance; tensile strength, ult. 1000-3000 lb. per sq. in.; compressive, 10-30,000; ductility, low; specific gravity, 2-2.15; used for bearings, valves, seals, nonfriction slides, piston rings, etc.

See advertisement, Page 145

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MUELLER 600 Bearing Metal—Mueller Brass Co., Port Huron, Mich. Copper 56-60, lead .5 max., manganese 1.25-3.5, aluminum .5-2, silicon .5-1.2, iron .6 max., and remainder zinc; sold as extruded or extruded and drawn, and rods and bars, and as die forgings from rod. Tensile strength, 70-85,000 lb. per sq. in.; yield point (½ per cent extension) 45-50,000; elongation, in 2 inches, 20 to 10 per cent for die forgings. Specific gravity, 8.071; conductivity about 12 per cent of copper; nonmagnetic; good corrosive resistance against sea water; used as low speed heavily loaded bearings as it withstands damage from lubricants carrying considerable sulphur compounds. Used for high-speed bearings on hardened mating surfaces, cam faces and machine parts, subject to wear, such as pump rods and shafts, and forged connecting rods for high-speed service.

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MUMETAL—Allegheny Ludlum Steel Corp., Brackenridge, Pa. A very high permeability nickel copper iron alloy, that must be very high temperature, dry hydrogen annealed after fabrication. Sold principally in form of sheets, strip, bars, and laminations, also shields. For special electrical instruments and transformers requiring highest performance. Typical analysis—nickel 76, copper 4½, chromium 1½, balance iron.

See advertisement, Page 235

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MUREX—Metal & Thermit Corp., New York. A series of welding electrodes designed for welding mild steel, carbon-molybdenum steel U.S.S. Cor-Ten and Mayari, Cromansil, nickel steels, chrome-molybdenum, chrome-nickel, straight chrome, manganese, stainless and high-carbon steels and for building up and hard surfacing.

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NA, NA-1, NA-2—National Alloy Steel Division, Blawnox, Pa. Varying percentages of nickel and chromium.

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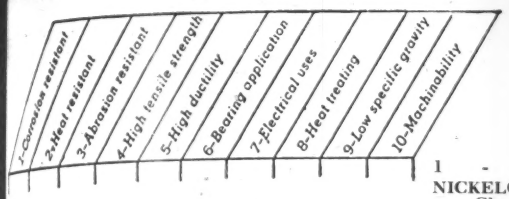
NACO—National Malleable & Steel Castings Co., Cleveland. Specialty processed cast steel; for service where heavy blows and constant friction require a material that combines great strength, toughness and resistance to wear; used in chains for steam shovel, dragline, draft gears, railway equipment.



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NATIONAL—National Molded Products Inc., St. Mary's, Pa. Copper 90, tin 10; furnished in powder; nonmagnetic; corrosion-resistant; heat-resistant to 400 degrees Fahr.; abrasion resistance, high; for bearings or intricate parts.

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NATIONAL Graphitic Steel—National Malleable & Steel Castings Co., Cleveland. High-strength steel furnished in castings. Has medium abrasion resistance, minimum tensile strength, 75,000 lb. per sq. in.; average; can be flame hardened, average brinell hardness, 200; used for automotive and other medium size castings requiring high strength and good machinability.

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N-A-X HIGH TENSILE—Great Lakes Steel Corp., Div. of National Steel Corp., Ecorse, Detroit. Carbon .1-.18, manganese .6-.75, silicon .65-.9, copper .25 max., Chromium .5-.65, nickel .1-.25, molybdenum .15 max., zirconium .1-.15, sulphur .04 max., phosphorus .04 max.; in rough bars or billets, finished rods or bars, sheets, strips and plates; corrosion-resistant; resists heat to 700 degrees Fahr; medium abrasion resistance; tensile strength, 75-85,000 lb. per sq. in.; high ductility; good bearing properties and weldability; brinell hardness, untreated 149,156, heat-treated 230-375; used for machine parts where high torsional properties, high tensile strength and resistance to fatigue and notch impact at normal and sub-zero temperatures are required.

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NELOY—National-Erie Corp., Erie, Pa. Steel castings, rough, finished, machined or flame hardened; high strength and hardness due to combination of alloying and special hardening; high abrasion resistance. Used for various applications in rolling mills and steel works equipment, overhead traveling cranes, power shovels, drag lines, and other heavy machinery.

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NEOR—Darwin & Milner Inc., Cleveland. High-carbon, high-chrome steel; carbon 2.25, chromium 13, vanadium .2, manganese .4, silicon .5 and nickel .5; in rough bars or billets, finished rods and bars; for hot forging, turning and boring. Mechanical properties in heat-treated state are ult. tensile strength, 160,000 lb. per sq. in.; compressive, 240,000; yield point (untreated) 66,000; elongation (annealed) 9 per cent; impact resistance, low; hardness, up to 66 Rockwell C; specific gravity, 7.76; magnetic; heat resistant to 1400 degrees Fahr.; abrasion resistance, very high; used for slitting cutters, lamination dies, etc.

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NEY-ORO G—The J. M. Ney Co., Hartford, Conn. Gold-platinum-silver-copper alloy in wire, sheets, coiled strips, and plates; for stamping, turning, boring, welding and soldering. Mechanical properties in heat-treated state; ult. tensile strength 160,000 lb. per sq. in.; yield point, 154,000; elongation, 6 per cent; impact resistance, high; hardness, 280 brinell; non-magnetic; weldability, good; abrasion resistance, medium; for pivots, small bearings, springs and electrical contacts.

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NICHROME—Driver-Harris Co., Harrison, N. J. Acid and alkali, heat resistant alloy consisting of nickel 60, iron 25, chromium 15; resists heat to 2000 degrees Fahr.; recommended for furnace parts, acid dipping baskets, and filter screen.

A; nickel 62, chromium 15; heating element material; also for electrical devices including rheostats, potentiometers, seamless tubing, etc.

B; as an addition to cast iron; sold in ratios of 5 and 2½ parts of nickel to 1 part of chromium.

V; nickel 80, chromium 20; heating element material; also in sheets for welded tubing.

Cast Nichrome; for furnace parts, pyrometer protection tubes, conveyor castings and carburizing containers. Sheet Nichrome S; sheet; nickel 27, chromium 15, used for various applications.

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NICKELCHROMEWELD—Lincoln Electric Co., Cleveland. Heavily coated electrode of shielded arc type for welding of Inconel and similar alloys of 70-80 per cent nickel, 11-15 per cent chromium and 5-10 per cent iron.

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NICKELOID—American Nickeloid Co., Peru, Ill., Nickel bonded to zinc, latter serving as rustproof, flexible and inexpensive white metal base. Available in variety of brilliant finishes and patterns, as sheets, flat strips and coiled strip for continuous feed automatic presses. Can be supplied with quick removable, gum-adhered paper covering permitting drawing and forming without marring prefinish.

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NICUITE—A. W. Cadman Mfg. Co., Pittsburgh, Nickel bronze; tin 10, nickel 3.5, zinc 2.5, trace of phosphorus, balance copper; high compressive strength for slow or medium speed operation under extreme pressures.

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NI-HARD—International Nickel Co. Inc., New York, and licensees. Nickel 4.5, chromium 1.5, total carbon 2.7-3.6; cast iron for chilled rolls, grinding balls, mill liners, etc., where abrasion is encountered.

See advertisements, Pages, 121, 216

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NILVAR—Driver-Harris Co., Harrison, N. J. A 36 per cent nickel steel having the lowest coefficient of expansion to 392 degrees Fahr. of an alloy; used for thermostatic controls in heating apparatus such as electric ovens, laboratory ovens, gas ovens, oil burners, and house heating apparatus.

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NI-RESIST—International Nickel Co. Inc., New York and licensees. Nickel 14, copper 6, chromium 2, total carbon 2.60-3.10, silicon 1.25-2, manganese 1-1.5; for castings handling corrosive waters and other solutions, or heats above the range of temperature where ordinary cast iron gives good service; resists corrosive vapors, gases and liquids; recommended instead of plain cast iron under such conditions.

See advertisements, Pages, 121, 216

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NIREX—Driver-Harris Co., Harrison, N. J. Acid-resisting material with tensile strength, annealed, up to 95,000 lbs. per sq. in.; spring temper 180,000; supplied in finished rods or bars, wire, sheets and strip; also can be fabricated by sand castings; for use where corrosion and heat resistance, and spring properties will be useful.

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NI-TENSYLIRON—International Nickel Co. Inc., New York, and licensees. Nickel 1-4, total carbon 2.5-3.15, silicon 1.2-2.75, manganese .5-.9; for machine tool castings, diesel engine housings, auto cylinder blocks, pistons, etc.

See advertisements, Pages, 121, 216

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NITRALLOY—Nitralloy Corp., New York, controls nitriding process and licenses under which alloy is produced. A chromium-molybdenum-aluminum steel capable of developing extreme hardness through nitriding; for cams and camshafts, gears, pump parts, splined shafts, cylinder liners, etc. Licensees include Allegheny Ludlum Steel Corp., Bethlehem Steel Co., Crucible Steel Co. of America, Firth-Sterling Steel Co., Republic Steel Corp., Rotary Electric Steel Co., The Timken Roller Bearing Co., Vanadium Alloys Steel Co., Copperweld Steel Co., and Atlas Steels Ltd.

See advertisement, Page 130

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NUREX—National Malleable & Steel Castings Co., Cleveland. A chromium-manganese-carbon alloy furnished in castings; resists corrosion caused by dilute aqueous solutions and acids (except phosphoric); resists heat to 1700 degrees Fahr.; abrasion resistance, high ductility, low; used for mill balls, lining and similar purposes.

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OHMALOY—Allegheny Ludlum Steel Corp., Breckenridge, Pa. An alloy for high electrical resistance applications, such as motor starters, crane motor controls, and mine locomotive controls. Available in all forms. Approximate analysis—chromium 12, aluminum 4¼, iron balance.

See advertisement, Page 235

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OILITE—Chrysler Corp. Amplex Div., Detroit, Mich. Oil cushion, heavy-duty bronze bearings containing one-third oil by volume; used extensively in aircraft, aircraft instruments, tanks, trucks, etc.

Super-Oilite; a porous oil cushion extreme pressure self-lubricating bearing permitting an allowable bearing load of 50,000 lb. per sq. in.; under zero velocity; furnished as finished parts or in bars, plates, and irregular shapes; good bearing properties; high porosity oil cushion; high strength, ductility; for landing gears, controls, locomotives, etc.

Super-Oilite "16"; a porous oil cushion extreme high-pressure self-lubricating bearing; has high oil content, extreme hardness with an allowable bearing load exceeding 100,000 lb. per sq. in. under zero velocity, and excellent bearing qualities; for bearing applications.

Iron-Oilite; a porous pure iron self-lubricating bearing, oil impregnated; copper free, porous oil cushion bearing; resists corrosive effects of sulphur, its compounds and similar agents; used for bearings in pumps.

Aluminum-Oilite; a porous lightweight self-lubricating oil impregnated bearing; porous; eliminates galvanic action with surrounding aluminum housings often discovered with bearings which form a galvanic cell with aluminum; used for bearings for aircraft controls, and wherever lightness is important.

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OLYMPIC BRONZE—Chase Brass & Copper Co., Waterbury 91, Conn.

Type A; copper 96, silicon 3, zinc 1; tensile strength, 55-150,000 lb. per sq. in.; brinell hardness 70-200; annealed at 1100-1200 degrees Fahr. if necessary to soften for additional cold working; resists corrosion due to saline, acid and alkaline solutions; used for welded structural parts, bolts, nuts, tubing, tie rods, etc.

Type B; copper 97.5, silicon 1.5, zinc 1; tensile strength, 45-90,000 lb. per sq. in.; annealed at 1100-1200 degrees Fahr. if necessary to soften for additional cold working; resists corrosion due to saline, acid and alkaline solutions; used for bolts, nuts, pipe and tubing.

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OREIDE—Scovill Mfg. Co., Waterbury, Conn. Copper 90, tin .5, balance zinc; in finished rods or bars, tubing, wire, sheets and strips (coiled); for stamping, turning, boring, etc., into machine parts; medium abrasion resistance; tensile strength, 95,000 lb. per sq. in. (hard drawn or rolled); specific gravity, 8.8; bearing properties fair; electrical properties fair; recommended heat treatments, anneal at 975-1025 degrees Fahr.; spring properties good; used primarily for spring contacts and switch parts.

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OSTUCO—Ohio Seamless Tube Co., Shelby, O. Precision tubing; seamless and electric-welded. Formerly known as Ohio Special Quality tubing.

See advertisement, Page 136

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OXWELD—Linde Air Products Co., The, New York.

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No. 1; welding rod for steel giving welds of high tensile strengths up to 70,000 lb. per sq. in.

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No. 7; drawn iron welding rod giving welds where high tensile strength is not a factor.

No. 9; cast iron rod (round) for gray iron castings.

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No. 23; welding rod for cast aluminum and aluminum alloys, giving high tensile strength.

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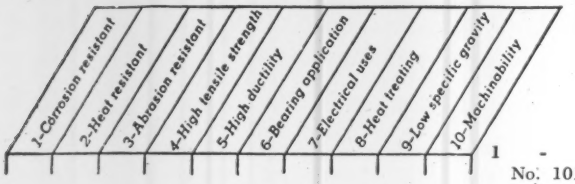
No. 25M; bronze welding rod having brinell



hardness of 96 and high tensile strength.

No. 28; a columbium bearing welding rod suitable for 18-8 stainless steel.

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PAINTGRIP—American Rolling Mill Co., Middletown, O. A special bonderized galvanized sheet (strip or coils) that takes and preserves paint.

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PALINEY—The J. M. Ney Co., Hartford, Conn.

No. 6; palladium-platinum-silver-copper-nickel alloy; in wire, sheets, coiled strips, and plates for stamping, turning, boring, welding and soldering. Mechanical properties in heat-treated state; ult. tensile strength, 170,000 lb. per sq. in.; yield point, 127,000; elongation, 15 per cent; hardness, 270 brinell; specific gravity, 10.9; nonmagnetic; abrasion resistance, medium; used for pivots, small bearings, springs, electrical contacts etc.

No. 7; similar to No. 6 in analysis with the addition of gold; available also in the same form. In heat-treated state, ult. tensile strength, 180,000 lb. per sq. in.; yield point, 148,000 elongation, 9 per cent; impact resistance, high; hardness, 280 brinell; specific gravity 11.9; nonmagnetic weldability, good; for same uses as foregoing.

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PAR—Crucible Steel Casting Co., Cleveland.

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No. 2; carbon .25, silicon .45, manganese .65, nickel 2.75, chromium 1.75, molybdenum .3, phosphorus .05; sand castings. Mechanical properties in heat-treated state: ult. tensile strength, 100,000 lb. per sq. in.; yield point, 75,000 lb. per sq. in.; elongation, 20 per cent; impact resistance, low; brinell hardness, 230; magnetic; abrasion resistance, high; can be heat-treated for good wear resistance.

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No. 6; carbon .2 max., silicon .85, manganese .7, chromium 25, nickel 12; sand castings. Mechanical properties in heat-treated state: ult. tensile strength, 80,000 lb. per sq. in.; yield point, 42,000 lb. per sq. in.; elongation, 32 per cent; impact resistance, high; brinell hardness, 165; specific gravity, 7.5; nonmagnetic; resists corrosion caused by sulphur dioxide; heat-resistant to 2000 degrees Fahr.; abrasion resistance, low; used for furnace parts and machine parts where corrosion resistance is desired.

No. 7; carbon .3, silicon .85, manganese .7, nickel 35, chromium 15; sand castings. Mechanical properties in untreated state: ult. tensile strength, 73,000 lb. per sq. in.; yield point, 41,000 lb. per sq. in.; elongation, 7 per cent; impact resistance, low; brinell hardness, 170; specific gravity, 7.8; nonmagnetic; resists corrosion caused by hydrofluoric acid solutions; heat-resistant to 2000 degrees Fahr.; abrasion resistance, low; for heat-treating furnace parts, carburizing boxes, etc.

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PERDURO—The Jeffrey Mfg. Co., Columbus, O. High-strength malleable iron for sand casting; resists corrosion due to analysis and heat treatment; resists heat to 1100 degrees Fahr.; higher abrasion resistance than malleable iron; tensile strength, 80,000 lb. per sq. in.; used for cast chains for drive and conveyor service.

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PERMITE—Aluminum Industries Inc., Cincinnati. Following grades available as sand castings, and permanent mold castings.

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No. 1002; copper 10, iron 1.5, magnesium .4, balance aluminum; for pistons for automotive, pump and refrigeration service.

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No. 1010; copper 4, silicon 1, balance aluminum; for machine parts to resist shock; heat treatment is to soak at critical and quench in water, and reheat at 350 degrees Fahr. to desired properties.

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No. 1019; furnished in ingots and sand castings and permanent mold castings; silicon 5, copper 1.25, magnesium .5, balance aluminum; heat treatment, quenching in water; suitable for highly-stressed parts including airplane engine parts.

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No. 2011; silicon 5, balance aluminum; for parts subject to atmospheric corrosion.

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No. 2021; magnesium 4, balance aluminum; for parts subject to salt water corrosion.

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No. 2023; magnesium 10, balance aluminum; for parts subject to high stress; furnished heat treated.

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PHOS-COPPER—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., brazing alloy manufactured in rod and strip form, containing 5-7 per cent phosphorus and balance copper; highly corrosion-resistant; gives strong joints when used for brazing copper and copper alloys to each other.

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PITTSBURGH STAINLESS STEELS—Pittsburgh Steel Co., Pittsburgh.

Stainless steels of various chromium-nickel-carbon types; 301, a high tensile material; 302, for food and meat packing equipment; 303, chrome-nickel free-machining type for screw stock; 304, similar to Type 302, advantageous for welded parts; 307, 308, to Army-Navy Specifications for ballistic welding; for cold heading requirements; 309, for welding rods where creep strength at elevated temperatures is a factor; 321, and 18-8 material with titanium added, for airplane parts; 347, similar to Type 321 but with better corrosion resistance; 310, chrome-nickel alloy for welding rod applications and where heat resistance is required; 316, chrome-nickel-molybdenum, acid-resistant, for chemical and textile industries; 317, similar to Type 316 but more corrosion-resistant; 410, heat treating type for use where high tensile and high rockwell hardness are desired; 414, similar to Type 410 but with somewhat different physical properties; 416, best machining qualities of these stainless steels but with only fair corrosion-resisting properties; 430, corrosion-resisting and fabricating properties not as good as Type 302, particularly good for trim; 446, high-resisting steel with reasonably high creep strength.

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PLANEWELD—Lincoln Electric Co., Cleveland. Shielded arc electrode for welding SAE 4130 and X4130 chrome-moly steels such as are widely used in airplane construction. For welding all positions.

Type No. 1; is intended for use on landing gears, tail wheel assemblies, etc. in metal thickness of .120-inch and up.

Type No. 2; is used for airplane tubing and similar construction of light gauges up to about 7/64-inch thickness. It gives a minimum of penetration. Slag is easy to remove.

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PLATINUM-CLAD—Baker & Co. Inc., Newark 5, N. J. Pure platinum welded to various base metals, in sheet, tubing and wire. Resists corrosion caused by usual acids; medium abrasion resistance; good weldability; tensile strength, ductility, etc., are dependent upon properties of base metals. Used for tubing exposed to acids and for vessels subject to same.

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PLURAMELT—Allegheny-Ludlum Steel Corp., Brackenridge, Pa. Combination of mild steel and stainless steel; in sheets, strips, and plates; for general fabrication; corrosion resistant; combines qualities of the stainless steel and plain steel of which it is composed.

See advertisement, Page 235

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POMPTON—Allegheny Ludlum Steel Corp., Brackenridge, Pa. Carbon .95-1.05; for arbors, bushings, collets and lathe centers. Water hardening.

See advertisement, Page 235

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POREX—Moraine Products Div., General Motors Corp., Dayton, O. Filtering and diffusing material product of powder metallurgy in bronze, iron, and other metals; provides high flow rates, low flow resistance; used in fuel and lubricating systems, instruments, breathers, burners, separators, etc.

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POWDIRON—Bound Brook Oil-Less Bearing Co., Bound Brook, N. J. Porous iron bearing alloys available in three grades. All have high compressive strength.

55P; contains no tin and only 5 per cent copper; used to conserve copper and tin; ult. tensile strength, 12,000 lb. per sq. in. specific gravity 5.5; compressive, 16-140,000 subject to corrosion under certain conditions but due to protective film of oil, will show less tendency to corrode than steel shaft.

61-IC; contains no tin and only 10 per cent copper, and is impregnated with 25 per cent of oil by volume; stronger than other materials furnished by company, and recommended for heavy-duty slower motion requirements where tensile strength is determining factor as in aviation and ordnance industries; ult. tensile strength, 30,000 lb. per sq. in.; compressive, 17-140,000

59-IC; straight-iron material impregnated with 25 per cent oil by volume, recommended for parts other than bearings which may or may not be sized to close dimensions; smooth mirror finished surface reduces friction; ult. tensile strength, 12,000 lb. per sq. in.; compressive, 22-130,000.

See advertisement, Page 246

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PRECISION—Precision Castings Co. Inc., Syracuse, N. Y.

Type A-12; aluminum base alloy; silicon 12, balance aluminum; resists heat to 1000 degrees Fahr., tensile strength, 33,000 lb. per sq. in.; specific gravity, 2.66; for general aluminum die casting uses.

Type ZN-5; Zinc base alloy; aluminum 4, copper 1, magnesium .04, balance zinc; tensile strength, 42,000 lb. per sq. in.; compressive, 85,000; specific gravity, 6.71; brinell hardness, 75; for general die casting uses—automotive, washing machines, electrical equipment, etc.

A-50; aluminum base alloy; silicon 5, balance aluminum; furnished as castings; resists corrosion caused by atmosphere, foods, etc., resists heat to 1000 degrees Fahr.; abrasion resistance, medium; tensile strength, ult., 29,000 lb. per sq. in.; ductility, medium; for use where corrosion resistance and ductility are essential.

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A-54; Aluminum base alloy; silicon 5, copper 4, balance aluminum; furnished as castings; resists corrosion caused by atmosphere, resists heat to 1000 degrees Fahr., tensile strength, ult., 32,000 lb. per sq. in., general aluminum die cast parts.

A-74; aluminum base alloy. Silicon 8.5, copper 3.5, balance aluminum. Substitute for A-54 alloy wherever possible. Conforms to Federal Specification AXS-679. Rev. 13.

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PRECISION TUBING—Precision Tube Co., Philadelphia. Seamless tubing in aluminum alloys, copper and brass, in sizes from ⅜-inch outside diameter down to .0125-inch outside diameter, with wall thicknesses down to .0015.

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PREMIER—American Steel & Wire Co., Cleveland. Specially processed steel wire having high yield and fatigue strength. Used for all types of spring applications.

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PROMAL—Link-Belt Company, Indianapolis. Specially processed malleable-iron having high yield and fatigue strengths; for resistance to mild corrosive attack can be furnished with copper content; can be hot dip galvanized without embrittlement and can be used in ovens and furnaces up to 1100 degrees Fahr.; uses include conveyor and drive chain links, bearing caps, rocker arms, sheaves, levers and other machine parts subjected to severe service.

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PROMET—The American Crucible Products Co., Lorain, O. Heat-treated bronze bearing metal having great compressive strength, low coefficient of friction, lubricating qualities; for bearings and wearing parts.

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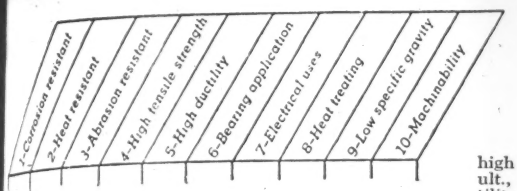
PYRAMID METAL—Magnolia Metal Co., Elizabeth, N. J. Lead-tin-antimony-arsenic alloy furnished in ingots. Ult. tensile strength, 17,-



850 lb. per sq. in.; yield point 8875; hardness, 25 brinell; abrasion resistance, medium; for applications where bearings must withstand heavy sustained pressures such as in marine reciprocating engines, water turbines, paper mill calendar stacks, etc.

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PYRASTEEL—Chicago Steel Foundry Co., Chicago. Nickel varies from 8 per cent up, chrome from 8.26 per cent; available as castings for heat-treating furnaces, screw conveyors, or any high temperature service to 2200 degrees Fahr. Also available in following grades:

No. 20; nickel 35, chrome 18.

No. 18; nickel 25, chrome 16.

No. 2000; chrome 26-28, nickel 14.

No. 14; chrome 6, molybdenum .5.

All of these grades carry a high silicon content, varying from 1-2.5 per cent.

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PYTHON—Allegheny Ludlum Steel Corp., Brackenridge, Pa. Carbon .85, vanadium .25; for chuck jaws, clutch pins and other parts requiring unusual wear and shock resistance. Water hardening.

See advertisement, Page 235

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RANDALL—Randall Graphite Products Corp., Chicago. S.A.E. No. 64 bronze or as specified; furnished as sand castings; resists corrosion caused by moisture; resists heat to 700 degrees Fahr.; high abrasion resistance; tensile strength, ult., 30,000 lb. per sq. in.; medium ductility; good bearing properties; conductivity, good; brinell hardness, untreated 80 for use as bushings; graphite-inserted in the perforated or drilled hole, grooved, or reservoir types.

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READYWELD—Lincoln Electric Co., Cleveland. Welding electrode for use with alternating-current transformer type welders which have low open-circuit voltage. Possesses arc stability with easy re-striking. For general welding work on light-gage sheet steel.

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RED ANCHOR—Anchor Drawn Steel Co., Latrobe, Pa. Carbon .95-1.1; commercial carbon drill rods; for precision shafts for motors, spindles, anvils and dental tools.

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REPUBLIC—Alloy Steel Div., Republic Steel Corp., Massillon, O. These alloy steels meet demands for material of lighter weight, greater strength, resistance to shock, impact and torsional strain, and high fatigue resistance; for severe service.

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REVALON—Revere Copper & Brass Inc., New York 17. Copper 76, aluminum 2.25, arsenic .04, balance zinc; in tubing and plates. In fabrication, material can be brazed, soldered or welded. Resists corrosion caused by high velocity, salt or brackish waters. Abrasion resistance, medium; tensile strength, ult., 55-80,000 lb. per sq. in.; ductility, high; specific gravity, 8.31; bearing properties fair; used for condenser tubes for utility, oil refinery, marine, heat exchangers, etc.

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REVERE CUPRO-NICKEL, 30 per cent—Revere Copper & Brass Inc., New York 17. Copper 70, nickel 30; furnished as finished rods or bars, tubing, sheets, strips (coiled) and plates; for fabricating into parts by stamping, extruding, welding, deep drawing or cold forging. Resists heat to 500 degrees Fahr.; abrasion resistance, medium; tensile strength, ult., 50-90 000 lb. per sq. in.; ductility, high; specific gravity ,8.95; for marine condenser tubes and condenser plate, cold-headed bolts and parts, etc.

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REX Z METAL—Chain Belt Co., Milwaukee. Furnished as castings; resists corrosion caused by weather and inorganic acids to a degree; resists heat to 1100 degrees Fahr.; high abrasion resistance; tensile strength, ult., 80,000 lb. per sq. in.; medium ductility; specific gravity, 7.45; good bearing properties; brinell hardness, untreated 200; for cast parts requiring high strength and good machinability.

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REZISTAL—Crucible Steel Co. of America, New York. Stainless steels available in the following grades:

301; carbon over .08-.2, chrome 16-18, nickel 6-8, manganese 2 max.

KA2, type 302; carbon over .08-.2, chrome 17-19; nickel 8-10, manganese 2 max.

2-C, type 302B; carbon over .08-.2, chrome 17-19, nickel 8-10, silicon 2-3, manganese 2 max.

FM-188, type 303; carbon .2 max., chrome 17-19, nickel 8-10, sulphur or selenium .07 min., molybdenum .60 max., manganese 2 max.

KA2S, type 304; carbon .08 max., chrome 18-20, nickel 8-10, manganese 2 max.

KA2S-2010, type 308; carbon .08 max., chrome 19-22, nickel 10-12, manganese 2 max.

No. 3S, type 309S; carbon .08 max., chrome 22-24, nickel 12-15, manganese 2 max.

No. 7, type 310; carbon .25 max., chrome 24-26, nickel 19-22, manganese 2 max.

No. 4, type 311; carbon .25 max., chrome 18-20, nickel 24-26, manganese 2 max.

KA2SMO, type 316; carbon .1 max., chrome 16-18, nickel 10-14, molybdenum 2-3, manganese 2 max.

KA2ST, type 321; carbon .1 max., chrome 17-19, nickel 8-12, titanium min. 4 × C, manganese 2 max.

KA2SCB, type 347; carbon .1 max., chrome 17-19, nickel 8-12, columbium 8 × carbon min., manganese 2 max.

Turbine, type 403; carbon .15 max., chrome 11.5-13.

405; carbon .08 max., chrome 11.5-13.5, aluminum .1-.3.

406; carbon .15 max., chrome 12-14, aluminum 3.5-4.5.

No. 12, type 410; carbon .15 max., chrome 10-14.

No. 122, type 414; carbon .15 max., chrome 10-14, nickel 2.5 max.

FM2, type 416; carbon .15 max., chrome 12-14, sulphur or selenium .07 min., molybdenum .6 max.

Gr. A, type 420; carbon over .15, chrome 12-14.

420F; carbon over .15, chrome 12-14, sulphur or selenium .07 min., molybdenum .6 max.

No. 17, type 430; carbon .12 max., chrome 14-18.

430F; carbon .12 max., chrome 14-18, sulphur or selenium .07 min., molybdenum .6 max.

No. 162, type 431; carbon .2 max., chrome 14-18, nickel 2.5 max.

Gr. B, type 440; carbon over .12, chrome 14-18.

441; carbon over .2, chrome 14-18, nickel 2.5 max.

No. 20, type 442; carbon .35 max., chrome 18-23.

No. 27, type 446; carbon .35 max., chrome 23-30.

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RIVERSIDE—Riverside Metal Co., Riverside, N. J. Phosphor bronze, nickel silver and beryllium copper in sheet, strip, wire and rod form.

See advertisement, Page 243

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ROL-MAN—Manganese Steel Forge Co., Philadelphia. Furnished in rods or bars, wire, sheets and plates, also hot forgings, stampings, wire cloth, welded and ground parts; contains manganese 11-14; carbon 1.1-1.4; resists heat to 400 degrees Fahr.; has high abrasion resistance; tensile strength, 140-160,000 lb. per sq. in.; compressive, 100,-000; high ductility; nonmagnetic; brinell hardness, heat treated 190-210; brinell work-hardened, 325-500; used where abrasion resistance and high strength are needed.

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ROMAN BRONZE—Revere Copper & Brass Inc., New York 17. Copper 60, tin .75, zinc 39.25; for forging, flanging, upsetting; uses include piston rods, bearing applications.

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RUSTLESS—Rustless Iron & Steel Corp., Baltimore.

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13-HC-35, type 420; carbon .4 max., chromium 12-14; hardening type of stainless steel; brinell hardness 550; used for valve parts, knife blades, abrasion and corrosion-resisting machine parts.

17-HC-60 and 90, type 440; carbon .6-1.1, chromium 14-18; hardening type of stainless steel; brinell hardness 625; used for same type of machine parts as type 420.

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25-12, type 309; carbon .2 max., chromium 22-26; nickel 12-14; highly resistant to heat and creep to 1300 degrees Fahr., scaling to 2000 degrees Fahr.; resists nitric-sulphuric acid mixtures and sulphite liquors; used for furnace and corrosion-resistant parts.

See advertisement, Page 131

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RUSTLESS 17 — Rustless Iron & Steel Corp., Baltimore.

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Type 430; carbon .12 max. and chromium 14-18; resists sulphur gases, nitric, and organic acids; nonhardenable; for corrosion-resisting rivets, screws, bolts and other parts.

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Type 430F; carbon .12 max., sulphur .15 min. and chromium 14-18; free-cutting stainless steel which resists heat to 1450 degrees Fahr.; tensile strength 100,000 lb. per sq. in.

See advertisement, Page 131

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SABECO—Saginaw Bearing Co., Saginaw, Mich.

No. 5 bearing bronze; copper 69-71, tin 4.5-5.5, lead 24-26, max., impurities .2; for light or medium load and water lubricated bearings.

No. 9; copper 69.71, tin 8.5-9.5, lead 20-22, max., impurities .2; for heavy loads such as average machine tool requirements.

No. 11; copper 69-71, tin 10.5-11.5, lead 18-20, max. impurities .2; for high pressures.

No. 11HG; copper 69-71, tin 10.5-11.5, lead 18-20, max. impurities .2; for worm wheels, clutch shifter shoes, forging machine slides, and extreme heavy bearing conditions.

No. 16; copper 69-71, tin 15-16.5, lead 13.5-14.5, max. impurities .2; for friction rings, and heavy-duty boring spindle bearings.

See advertisement, Page 114

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SANDUSKY ALLOY IRON—Sandusky Foundry & Machine Co., Sandusky, O. Nickel, chrome and molybdenum cast iron alloys; furnished in tubing, centrifugally cast and in finished cylindrical parts; resists corrosion; high abrasion resistance; tensile strength 25-60,000 lb. per sq. in.; brinell hardness, untreated, 160-300; heat-treated, 300-600; for rolls, liners, sleeves, bushings, cylinders, etc.

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SANDUSKY BRONZES — Sandusky Foundry & Machine Co., Sandusky, O. Bronze, brass and manganese bronze alloys; furnished in tubing, centrifugally cast and in finished cylindrical products; resists corrosion due to composition and superior structure; tensile strength 30-110,000 lb. per sq. in.; good bearing properties; brinell hardness, untreated, 40-250; used for rolls, liners, sleeves, bushings, cylinders, pipe, tubes of 3-46 inches in diameter and up to 330 inches in length.

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SATCO Bearing Metal—Magnus Metal Corp., Chicago. Lead-base alloy containing from 94-98 per cent lead, with balance tin, calcium and other auxiliary hardeners; melting point about 125 degrees higher than that of tin-base and lead-base babbitt metals, with higher resistance to deformation and wiping at elevated temperatures. Material is furnished in ingot form and also lined bearings. Mechanical properties in untreated state; ult. tensile strength, 11-13,000 lb. per sq. in.; compressive, 15-17.000; elongation, 8-12 per cent; hardness, 22-24 brinell; recommended as a lining for brass, bronze and steel back bearings. May be used as a substitute for lead and tin base babbitts, block tin and other bearing metals.

SCOVILL—Scovill Mfg. Co., Waterbury, Conn.

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A complete line of high and low brasses, phos-

1-Corrosion resistant | 2-Heat resistant | 3-Abrasion resistant | 4-High tensile strength | 5-High ductility | 6-Bearing application | 7-Electrical uses | 8-Heat treating | 9-Low specific gravity | 10-Machinability

phor-bronzes, nickel-silvers, and cupro-nickels for various mechanical, electrical and heat-exchanger purposes.

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Free-cutting brass rod; copper 61, lead 3, zinc 36; in finished rods or bars, for hot forging, turning, boring, etc. Resists heat to 500 degrees Fahr.; abrasion resistance, medium; tensile strength, ult., 55,000-75,000 lb. per sq. in.; ductility, medium; specific gravity, 8.5; bearing properties, fair. Specially adapted to fabricating on high-speed screw machines.

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Hardware bronze; copper 89, lead 2, nickel 1, balance zinc; furnished in rods, bars and wire for turning, boring, etc.; machinability, good; resists corrosion caused by atmospheric conditions; tensile strength, 38,000-85,000 lb. per sq. in.; specific gravity, 8.85; bearing properties, good; recommended heat treatment, annealing, 1000-1100 degrees Fahr.; brinell hardness, untreated, 48-125; used for screw machine products.

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Naval brass; copper 60, tin .75, zinc 39.25; in finished rods or bars, and tubing, for hot forging, welding, turning, boring, etc. Resists heat to 500 degrees Fahr.; medium abrasion resistance; tensile strength, ult., 60,000-90 000 lb. per sq. in.; ductility, medium; weldability, fair; specific gravity, 8.4; used for boat shafting, turn buckles, welding rod, etc.

70-30 copper nickel; copper 70, nickel 30; furnished in tube form; resists corrosion due to inorganic acids and alkalies, sulphur compounds, salt and brackish waters; good resistance to abrasion or erosion; resists heat to 600 degrees Fahr.; tensile strength, 55,000-100,000 lb. per sq. in.; recommended heat treatment, annealing 1100-1300 degrees Fahr.; brinell hardness, untreated, 70-150; used for condenser and heat-exchanger tubes.

Phosphor bronze; copper 92, tin 8; furnished in rods, wire, sheets and strips; for stamping, forming, turning, boring, etc., into machine parts; abrasion-resistant; electrical uses, bearing application. Excellent resistance to corrosion and fatigue. Tensile strength (sheet) 60,000-110,000 lb. per sq. in.; used for springs, diaphragms, bushings, etc.

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Phosphorized Admiralty tubes; copper 70, tin 1, phosphorus .03, zinc balance; in tubing; resists dezincification; resists corrosion caused by alkalies, weak acids, sulphur, petroleum compounds; resists heat to 500 degrees Fahr.; abrasion resistance, high; tensile strength, ult., (soft) 50,000 lb. per sq. in.; ductility, high; for condenser tubing, particularly where dezincification is to be expected.

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18 per cent nickel silver; copper 65, nickel 18, zinc 17; furnished in finished rods or bars, strips, wire and sheets; for turning, boring, stamping, and welding. Mechanical properties in untr ated state; ult. tensile strength, 60.000-90,000 lb. per sq. in.; nonmagnetic; resists corrosion caused by acids, mild alkalies, atmosphere, etc.; abrasion resistance, medium.

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SEALMET — Allegheny Ludlum Steel Corp., Brackenridge, Pa. Typical analysis—chromium 27, iron balance. Alloys having same coefficient of expansion as certain grades of glass. For applications where metal wires or strip must be attached directly to glass.

See advertisement, Page 235

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SELFLUBE—Keystone Carbon Co., Saint Marys, Pa. Self-lubricating porous bronze and porous iron, bearings and sleeves; yield point for bronze, 12,090 per sq. in.; 30 000 lb. per sq. in. min., 50.000 lb. per sq. in. max., for iron, ductility, high; for bearings, bushings, etc.; also bronze, brass and iron for structural parts.

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SEMINOLE — Allegheny Ludlum Steel Corp., Brackenridge, Pa. Carbon .45, chromium 1.3, tungsten 2, vanadium .25; for high-creep strength bolts and studs for superheated steam; also machine parts having high wear and fatigue values. Withstands moderately elevated temperatures. May be oil hardened.

See advertisement, Page 235

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SHARON—Sharon Steel Corp., Sharon, Penna. Stainless and heat-resisting alloy. Chrome-nickel group 17.7, chromium 17, nickel 7, carbon .09-.20. Used for automotive trim, for deep drawing where straight-chromium types are not sufficiently ductile.

18-8; chromium 18, nickel 8, carbon .08-.20; specially suited to resist atmospheric erosion and corrosion; for dairy and chemical plant equipment, food, meat, processing machinery, high strength, lightweight structural members and for resisting the oxidation of elevated temperatures.

Alloy, steel, hot and cold-rolled strip steel, hot and cold-rolled sheet steel, Galvanite, galvanized, tin, terne and zinc coated strip and sheet, also available.

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SHENANGO-PENN—Shenango-Penn Mold Co., Dover, O. Centrifugal castings in all bronzes, Monel metals and alloy irons—a complete range of red bronze alloys, as well as yellow metals including manganese bronzes and aluminum bronzes; also special alloys such as Monel metal, aluminum and silicon bronzes, copper, etc. Grades of plain and alloy iron, as well as Ni-Resist are available. Furnished in cast tubular bars or cylinders in sizes from 2-26 inches outside diameter and to 26 feet in length; solid bars in diameters ranging from ½ to 8 inches—in standard 6-foot lengths. For immediate delivery stock of both solid and tubular bars under 6¾ inches outside diameter is maintained. Extremely flexible, and can be adapted to any application where castings are used. Flanges and unusual shapes and sizes also available. For bearings, bushings, drums, liners, roll covers, sleeves, washers, rings, etc.

See advertisement, Page 236

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SHIELD-ARC—Lincoln Electric Co., Cleveland. Type 85; high-tensile welding rod; recommended for fabrication of high-tensile steels; brinell 190-250.

Type 100; brinell hardness 235-300.

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SHOCKPROOF—Lake City Malleable Co., Cleveland. Malleable iron of high tensile strength, high yield point and ability to withstand shock and abuse, possessing good machining qualities and resistance to corrosion; ult. tensile strength, 53 000-60.000 lb. per sq. in.; yield point, 35,000-40,000.

See advertisement, Page 254

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SICROMO — Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O.

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Type 1; carbon .15 max., manganese .5 max., phosphorus .03 max., sulphur .03 max., silicon 1-1.4, chromium .75-1.25, molybdenum .45-.65; furnished in rough bars or billets, finished rods or bars. and tubing, for hot forging, welding, turning, boring, etc. Material is corrosion-resistant; heat-resistant to 1050 degrees Fahr.; tensile strength. ult., 60.000 lb. per sq. in. min.: fair weldability; and brinell hardness: annealed 163 max. For use in oil refinery field.

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Type 2; similar to above with slightly higher chromium content.

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Type 2½; similar to Type 2 with slightly lower silicon content.

Type 3; similar to Type 2½, with slightly higher silicon and chromium content.

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Type 5; similar to Type 3, with lower silicon content and higher chromium.

Type 5S; similar to Type 5, differing only in higher silicon content.

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Type 7; similar to Type 5S, having lower silicon and higher chromium content.

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Type 9; similar to Type 7, having higher chromium content. All above materials are for oil refinery use.

Type 7M; similar to Type 7, but having an increased molybdenum content.

Type 9M; similar to Type 9, but having an increased molybdenum content.

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SIL-FOS—Handy & Harman, New York 7. Brazing alloy containing silver 15, copper 80, phosphorus 5; flows at 1300 degrees Fahr.; furnished in rods, wire, sheets and strips (coiled); corrosion-resistant; high ductility; specific gravity 8.45; used to join nonferrous metals only, particularly copper, brass and bronze.

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SILFRAM—Stoody Co., Whittier, Calif. A cast hard-facing rod of chromium, nickel, silicon, carbon and iron; good bearing surface; excellent resistance to corrosion; can be machined with carbide tools; Rockwell C hardness 37-41; for hard-facing equipment subject to corrosion, abrasion and impact, such as pump sleeves, valves, etc.

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SILMO—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O. Carbon .15 max., manganese .5 max., phosphorus .04 max., sulphur .045 max., silicon 1.15-1.65, and molybdenum .45-.65; furnished in rough bars or billets, finished rods or bars, and tubing, for hot forging, welding, turning, boring, etc., into parts. Tensile strength, ult., 55.000 lb. per sq. in. min.; resists heat to 1000 degrees Fahr.; fair weldability; brinell hardness annealed 163 max. For use in oil refinery field.

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SMAVROC—The Medart Co., St. Louis. Alloy steel forgings for rolls for steel or nonferrous mill bar straighteners.

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SOFTWELD—Lincoln Electric Co., Cleveland. For arc welding cast iron where easy machinability is required.

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SPEED CASE—Monarch Steel Co., Indianapolis, and affiliate, W. J. Holliday & Co., Hammond, Ind. A low-carbon open-hearth steel (X1515) furnished in hot-rolled plate and cold-rolled bars. Typical analysis: Carbon .20, manganese 1.25, sulphur .25, phosphorus .03 max., silicon .02 max. Tensile strength, 62,000-72,000 lb. per sq. in.; impact resistance at low temperatures and ductility equal to or better than SAE 1020. Machines readily, 150-250 s.f.p.m. (average). Case hardens rapidly with deep, uniform penetration. Has low hysteresis loss. Can be forged, cold-formed or rolled and welded. Widely used for machine tables.

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SPEED TREAT—Monarch Steel Co., Indianapolis, and affiliated company, W. J. Holliday & Co., Hammond, Ind. A medium-carbon, open-hearth steel plate (X1545) furnished in hot-rolled plate and cold-rolled bars. Typical analysis: Carbon .4-.5, manganese 1.1-1.45, phosphorus .02 max., sulphur .2-.3, silicon .03 max.; tensile strength, 93,650-95,300 lb. per sq. in. Impact resistance at low temperatures, ductility and equal to or better than SAE 1045. Machines upward of 30 per cent faster than SAE 1045. Case-hardens rapidly, with deep, uniform penetration. Can be forged and welded. Used for gears, welded power shovel dippers, bearing plates, etc.

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STA-GLOSS—Jessop Steel Co., Washington, Pa.,

A, type 420; stainless steel: ult. strength, 230,000 lb. per sq. in.; yield point 220,000 lb. per sq. in.; elongation in 2 inches, 2½; brinell hardness, 500; used for gears, pump rods, etc.

B, type 440; stainless steel: ult. strength, 280,000 lb. per sq. in.; yield point 250,000 lb. per sq. in.; brinell hardness, 580; used for engine parts, gages, etc.

C, type 440; stainless steel; ult. strength, 310,000 lb. per sq. in.; yield point 270,000 lb. per sq. in.; brinell hardness, 600; used for valve seats, bearings, etc.

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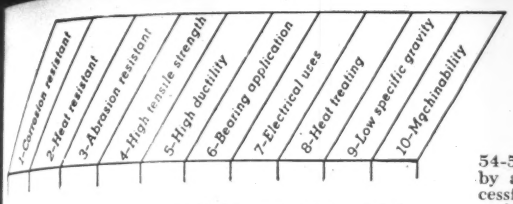
STAINWELD—Lincoln Electric Co., Cleveland. Coated, electrode for welding stainless steels or building up surfaces to resist corrosion.

Type A-5; for large number of so-called 18-8 stainless steels. Welds are of high tensile strength and ductility and possess same resistant qualities as the parent metal. Contains suitable amount of columbium to prevent intergranular corrosion of deposited metal.

Type A-7; for stainless steels of 18 per cent chromium, 8 per cent nickel type; fast-flowing, smooth operating; especially adapted for surfacing other steels with minimum admixture of base metal.

Type B; for arc welding stainless steel with chemical content of approximately 25 per



cent chromium and 12 per cent nickel. Physical properties equal to metal welded.

Type C; a modification of the well-known 18-8 analysis, commonly known as 18-8 SMO (approx. 3½ molybdenum). Suitable for welding stainless steels of types 316-317 (Iron and Steel Institute).

Type D; for stainless steels of 25 per cent chromium, 20 per cent nickel types; also for welding stainless steels to mild steel and for welding steels which are air-hardened and cannot be heat treated after welding.

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STANNUM BABBITT—Lumen Bearing Co., Buffalo 12, Tin base bearing babbitt.

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STELLITE—Haynes Stellite Co., Kokomo, Ind.

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Non-ferrous cobalt-chromium tungsten alloys; for corrosion and wear-resistant castings; hard-facing welding-rod for parts subject to abrasion or a combination of abrasion, heat and corrosion. Metal-cutting tools of non-ferrous cobalt-chromium-tungsten alloy, as solid, square and rectangular bits, welded-tip tools and special tools.

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Type 93; ferrous alloy welding-rod for hard-facing metal wearing parts; abrasion resistance, high; tensile strength, ult., 43,040 lb. per sq. in. average; Rockwell hardness, untreated C-62, heat treated, average C-67.

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STERLING Stainless Steels—Firth-Sterling Steel Co., McKeesport, Pa.

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Type A (420); carbon .35, chromium 13.5; corrosion-resistant; tensile strength 240,000 lb. per sq. in.; for ball bearings and automotive parts subject to wear. Good physical properties in heat-treated state; maximum resistance to corrosion secured by hardening and thorough grinding.

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Type T (410); carbon .10, chromium 13; possesses maximum strength and elasticity without sacrifice of toughness; machinable and corrosion-resistant; for pump rods, shafts, valve parts, gun barrels, pistons and machinery parts where strength is of greater importance than ease of machining.

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Type TX (403); modified Type T used for turbine blading.

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Type FC (416); free-cutting stainless steel wherein a slight sacrifice in physical properties and corrosion resistance is made to obtain easier machining; for machine parts including screws, bolts, nuts, pump shafts, valves and spindles.

Type M (430); soft ductile steel that does not work-harden readily; requires no heat treatment to secure corrosion resistance.

Type BHH (440-C); for bearings; extremely hard and resistant to abrasion.

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Types 18-8 (302), 18-8-S (304), and 18-8-FC (303); chrome-nickel group containing approximately 18 per cent chromium and 8 per cent nickel with various modifications or additions to give special physical properties, machinability or resistance to certain corrosive action; the free-cutting type can be easily machined, and cold work-hardened wire and strip have great strength and resiliency.

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STOODEX—Stoody Co., Whittier, Calif. A cast hard-facing rod of chromium, cobalt tungsten, carbon and iron; can be applied very smooth and thin; requires minimum of grinding; used where smooth, thin deposits are required, also where parts are subject to abrasion and impact such as plow moldboards, clutch fingers, expeller parts, etc.

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STOODITE—Stoody Co., Whittier, Calif.

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Cast hard-facing rod composed of chromium, manganese, zirconium, silicon, carbon and iron; makes excellent bearing surface; resists galling and pitting; Rockwell C hardness, 54-58, used for hard-facing parts abraded by attrition or sliding friction; equally successful for hard-facing parts abraded by earth such as plow shares or other metals such as steel mill guides.

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Types 45, 54, 63; a series of special alloys ranging in physical properties from extreme toughness to extreme hardness. Rockwell C hardness is indicated by numbers. Used chiefly on lathes, coilers, boring mill tools, lathe centers, hot punches, blanking dies, thread gages, etc.

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STOODY—Stoody Co., Whittier, Calif.

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Type A.C.; a rod of high-carbon steel core and coating containing alloying elements principally chromium, manganese, silicon, carbon and iron; can be forged; Rockwell C hardness, 53-56; for hard-facing all types of equipment subject to abrasion and impact where applications must be made by alternating current machines.

Self-hardening; a fabricated hard-facing rod of chromium, manganese, silicon, molybdenum, carbon and iron; forms excellent bond with manganese steel; can be forged; Rockwell C hardness, 52-54; used chiefly for hard-facing crusher bucket lips and other equipment subject to abrasion and impact.

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Type No. 1; cast hard-facing rod composed of cobalt, chromium, tungsten; has high resistance to corrosion and abrasion; retains hardness, wear-resistance at red heat; Rockwell C hardness, 54. Used for hard-facing wood saw teeth, underreamer lugs, carbon scrapers, wire guides, pump sleeves, etc.

Type 6; cast hard-facing rod composed of cobalt, chromium and tungsten; has high resistance to abrasion and corrosion; retains hardness and wear resistance at red heat, Rockwell C hardness 41-43. Used for high-pressure, high-temperature steam valves, hot trimming dies, exhaust valves and valve seats.

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Tube Borium; a rod made of various screen sizes of irregularly shaped particles of cast tungsten carbide contained in steel tubes; high wear resistance; will cut nonmetallic substances; hardness 9-10 on Moh's scale, deposits being heterogeneous. Used on earth-working equipment, drilling and scraping operations, also for hard-facing.

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STRAINFREE ELASTUF PENN (Cold-finished)—Horace T. Potts Co., Philadelphia. Steel of manganese type without chromium, furnished in finished rods or bars; tensile strength 140,000 lb. per sq. in.; medium ductility; nondistorting; high physicals; cold finished; brinell hardness, untreated 269. Used for parts whose length exceeds cross-sectional dimension as gears and worms with integral shafts, and feed and lead screws.

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STRESSPROOF—La Salle Steel Co., Hammond, Ind. A modified SAE X1340 steel in finished bars for machining; yield point 100,000 lb. per sq. in. and 90,000 depending upon the size; used for worm gears, lead screws, spindles, shafts and speed reducers.

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SUMET—Sumet Corp., Buffalo. High-leaded bronzes as follows:

SM-4; lead 28 per cent; for high-speed and light-duty service.

SM-8; lead 26 per cent; for moderate speed and general service; suitable for machine tool bearings.

SM-10; lead 24 per cent; for general applications such as aeronautical engines, clutch cones and disks, compressors, connecting rods, crank pins, etc.

SM 12; lead 22 per cent; for cone and gyratory crushers, crane and ore machinery, mining machinery, etc.

SM 16; lead 20, for heavy-duty service such as crane motor compressor, dredging machinery, etc.

SM 18; lead 17.5 per cent; for cross-head pins, cranes, railroad, steam shovel, etc.

SM 14; lead 14 per cent; for thrust bearings, gears, etc.

SM 22; lead 10 per cent; for special steel mill applications.

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SUMMERILL—Summerill Tubing Co., Bridgeport, Pa. Seamless tubing in practically all regularly used carbon grades from SAE 1010 to SAE 1095. Others are chrome molybdenum SAE 4130X, 4140, 4150, 4185, 52,100, 4340, NE-8630, NE-8635, nickel-silver, pure nickel-silver, corrosion-resistant steels—18-8, 16-13-3 and similar grades; 4 to 6 per cent chrome with ½ moly; also some of 12-14 per cent chrome, beryllium copper, K-Monel and Invar. Available in any shape, and in sizes ranging from .012-inch to 5½ inch outside diameter. Used for mechanical specialties, aircraft, industrial control instruments, fuel injection tubing for diesel engines, etc.

Also tapered and formed tubes for many special parts.

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SUPERIOR Copper Steel—Superior Metal Co., Chicago. Corrosion-resistant steel electro-copper-plated; in sheets and coiled strips for stamping and welding; resists corrosion caused by moisture; resists heat to 1400 in controlled oxidation; abrasion resistance, medium; weldability, fair, used to substitute for solid copper sheet and strip.

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SUPERIOR Seamless Tubing—Penn Brass & Copper Co., Erie, Pa. Seamless brass and copper tubing from 5/64-in. outside diameter x .010-inch wall, to and including 1-inch outside diameter x .072-inch wall, both in copper of pure electrolytic mixture and in brass on 3 alloys, namely 70/30, 2-1 leaded, and 85/15.

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SUPERIOR Stainless Steel—Superior Steel Corp., Carnegie, Pa. Hot and cold-rolled strip steel and stainless steels in all grades and analyses.

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301; chromium 16-18, nickel 6-8, carbon .09-.2; in coils or strips for stamping and welding; ult. tensile strength (heat treated), 95-100,000 lb. per sq. in.; impact resistance, high; nonmagnetic; weldability, good; used for trim, wearing plates, parts where strength is needed, airplane parts, etc.

302; chromium 17-19, nickel 8-10, carbon over .08-.2; in coils or strips for stamping and welding; in heat-treated state, ult. tensile strength, 90-95,000 lb. per sq. in.; yield point, 30-40,000; elongation 55-65 per cent; impact resistance, high; for use same as type 301.

321 and 347 titanium and columbium stabilized stainless steels are also available.

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410; chromium 11.5-13.5, carbon .15 max., annealed; in coils or strips for stamping and welding; ult. tensile strength, 60-75,000 lb. per sq. in.; yield point 35-45,000; abrasion resistance, high; for plates, brackets, etc.

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430; chromium 14-18, carbon .12 max.; in coils or strips for stamping and welding; ult. tensile strength, 70-80,000 lb. per sq. in.; yield point 45-55 000; heat resistant to 1500 degrees Fahr.; abrasion resistance, high; for wearing plates, bright parts trim, etc.

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SAE X4130; carbon .27-.33, manganese .4-.6, phosphorus .04-.05 max., chromium .8-1.1, and molybdenum .15-.25; in coils or strips for stamping and welding; ult. tensile strength, 90,000 lb. per sq. in.; yield point, 70,000 min.; elongation in 2 inches, 10-20 per cent; weldability good; for highly stressed or critical parts as aircraft work.

Also materials fulfilling requirements of government specifications AN, QQ-S-772, AN, QQ-S-757 and U. S. Navy 47-S-20. Hot and cold rolled strip steel, high carbon, low carbon alloys, including X4130 and Nitralloy.

See advertisement, Page 219

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SUPERIOR Strip Steel—Superior Metal Co., Chicago 38. Brass and copper-coated cold-rolled strip steel, furnished in coil form; magnetic, low abrasion resistance.

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SUPERMAL—The Jeffrey Mfg. Co., Columbus, O. High-strength malleable iron; resists heat to 400 degrees Fahr.; higher abrasion resistance than malleable iron; tensile strength 70,000 lb. per sq. in.; medium ductility; brinell hardness; heat-treated, 180-200; used for cast chains for drives and conveyors.

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SUPERSTRIP—Acme Steel Co., Chicago. Hot and cold-rolled strip steel; furnished in sheets and strips (coiled) for stamping into parts.

1-Corrosion resistant | 2-Heat resistant | 3-Abrasion resistant | 4-High tensile strength | 5-High ductility | 6-Bearing application | 7-Electrical uses | 8-Heat treating | 9-Low specific gravity | 10-Machinability

Material is furnished to specifications and is available in most sizes from ¼ to 22 inches in width and in thickness from ¼-inch and less.

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SUPERTEMP—Bethlehem Steel Co., Bethlehem, Pa. A patented alloy steel having high strength at high temperatures; suitable for bolts and studs for reaction chambers, cracking stills, superheaters, etc.

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SURFACEWELD—Lincoln Electric Co., Cleveland. A fine-grained alloyed powder for application with the carbon arc. Gives smooth abrasion resisting surface. Can be applied in thin layer. Properly applied, coating will have a hardness of 54 Rockwell C. Maintains hardness and resists scaling at high temperatures. Corrosion resistance comparable to stainless steel.

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SUVENEER—Superior Steel Corp., Carnegie, Pa. Steel clad on one or both sides with silver, stainless, copper, and some copper base alloys, etc.; furnished in strips; for stamping, welding, deep drawing, rolling, spinning, soldering, etc. Mechanical properties in annealed state: Ult. tensile strength, 50,000 lb. per sq. in.; yield point, 35,000 lb. per sq. in.; elongation, 30 per cent; brinell hardness, 50-60; magnetic; for bearing applications and electrical uses.

See advertisement, Page 219

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TALIDE—Metal Carbides Corp., Youngstown, O. Tungsten carbide metal; resists corrosion due to high tungsten content; heat resistant to 2000 degrees Fahr.; high abrasion resistance; tensile strength 300,000 lb. per sq. in.; specific gravity 14.1; brinell hardness, untreated, 130 and over; for use as wear plates and guides, cutting tools, drawing dies and bushings.

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TALON—Steel Tube Div., Talon Inc., Oil City, Pa. Electric resistance welded carbon steel tubing for both pressure and mechanical applications. Available in sizes from ⅝-inch to 4 inches outside diameter, and in lengths up to 40 feet.

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TAMCO—Titanium Alloy Mfg. Co., Niagara Falls, N. Y. Alloys including original high and medium carbon ferro carbon-titanium, foundry ferro-titanium, and several varieties of low-carbon ferro-titanium for rolled, cast and forged steels, stainless and alloy steels, and gray cast iron.

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TAWILCO — Taylor-Wilson Mfg. Co., McKees Rocks, Pa. Iron base casting; responds to heat treatment for hardening or strengthening, will also flame-harden well. Mechanical properties in untreated state: Ult. tensile strength, over 50,000 lb. per sq. in.; compressive, 165,000; yield point, 45,000 lb. per sq. in.; elongation .1 per cent; impact resistance, low; endurance limit (completely reversed bending), 20.000 lb. per sq. in.; brinell hardness, 174-500 depending on grade; specific gravity 7.01-7.5; magnetic; weldability, fair; heat-resistant to 1500 degrees Fahr.; abrasion resistance, high; for all machine parts requiring strength, dampening capacity, rigidity, wearing properties, etc.

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TELNIC BRONZE—Chase Brass & Copper Co., Waterbury 91, Conn. Copper 88.5, zinc 9.68, nickel 1.1, phosphorus .22; tellurium .5. A hard high-strength forgeable, age-hardenable, machinable bronze for general engineering and structural uses.

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TEMPALOY—American Brass Co., Waterbury, Conn. Copper-aluminum-nickel alloys which yield to heat treatment; abrasion resistant; uses include motor boat shafting, piston rods, bearing applications, etc.

See advertisements, Pages 147-153

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TENUAL—The National Bronze & Aluminum Foundry Co., Cleveland. Unmachined sand and permanent mold aluminum castings.

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THERMALLOY—The Electro-Alloys Co., Elyria, O. Nickel-chromium material; weight density, .3 lb. per cu. in.; heat-resistant up to 1900.

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THOMASTRIP—Thomas Steel Co., Warren, O. Cold-rolled strip steel, bright finish uncoated and electro-coated in brass, bronze, nickel, zinc, tin and copper.

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TIGERLOY—Massillon Steel Casting Co., Massillon, O. Nickel-molybdenum; for shovel castings, gears, crane track wheels, castings for impact resistance, etc.

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TIMANG—Taylor-Wharton Iron & Steel Co., High Bridge, N. J. Nickel-manganese steel; can be rolled, drawn, forged or shaped; for journal box liners, pedestal gib liners, conveyor flights, welding rod, etc.

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TIMKEN—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O.

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Type 17-22A; carbon .3-.35, manganese .5 max., chromium 1-1.5, molybdenum .45-.65, vanadium .25-.35, in rough bars or billets, and finished rods or bars; for hot forging, turning, boring, etc. Heat-resistant to 1200 degrees Fahr.; tensile strength, ult. 200.000 lb. per sq. in., min., heat-treated; medium ductility; and brinell hardness, untreated 200, heat treated 470 max. Used for bolts, studs and other highly stressed parts at elevated temperatures.

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Type 18-8; carbon .07 max., manganese .2-.7; silicon .75 max., chromium 17-20, nickel 8-10. This austenitic nonmagnetic alloy shows very good combination of creep and rupture strength, oil corrosion resistance, and oxidation resistance for service up to 1500 degrees Fahr.

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Type 16-13-3; carbon .13 max., manganese 1.5 max., chromium 15.5-17, nickel 12.5-14.5, molybdenum 2.5-3.25. This molybdenum modification possesses higher creep and rupture strength than the standard 18-8 analysis and is also more resistant to certain types of corrosion, especially those associated with pitting.

Type 4-6 Cr.Mo.; carbon .15 max., manganese .5 max., silicon .5 max., chromium 4-6, molybdenum .45-.65. For service up to 1200 degrees Fahr. where corrosion resistance to hot petroleum products is a primary requirement. Inferior in its oxidation and corrosion resistance to Sicromo 5S.

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Type .5 Mo. Steel; carbon .1-.2, manganese .3-.6, silicon .5 max., molybdenum .45-.65. For temperatures up to 1000 degrees Fahr. the satisfactory creep strength allows for greater safety than can be obtained from carbon steel. The oxidation and corrosion resistance, however, is similar to that of carbon steels.

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TISCO—Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

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Stainless steel castings of all compositions, including chrome-molybdenum, nickel-chrome-molybdenum, 18-8 chrome-nickel, and high chromium.

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Manganese steel castings for shock and abrasion resistance. Used primarily for rock crushers, ball mill liners, sprockets, etc.

Carbon steel castings. Also Alnico and related magnet alloys.

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TOBIN BRONZE—American Brass Co., Waterbury, Conn. Copper 60, zinc 39.25, tin .75; abrasion-resistant; uses include piston rods, boat shafting, condenser head plates, welding rods, seamless tubes, etc.

See advertisements, Pages 147-153

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TOLEDO ALLOY—Unitcast Corp., Steel Casting Div., Toledo, O.

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No. 4; abrasion-resistant silicon-molybdenum steel with good hardening properties; used for mining tools, wear plates, crusher plates and pinions.

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No. 6; air-hardening die steel of uniform machining qualities; long life under severe wear.

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No. 131; carbon .22-.28, manganese .7-.8, copper 1-1.2, vanadium .04-.08, silicon .4-.5, furnished in castings; tensile strength, 90,-100,000 lb. per sq. in.; high ductility; for use where high strength and ductility are required and when hardness is of lesser importance.

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No. 135; carbon .4-.5, manganese .75-.85, chromium .9-1.1, copper 1-1.15, molybdenum .25-.35; furnished as castings; resists corrosion caused by copper; abrasion resistance, medium; tensile strength, ult., 120 000 lb. per sq. in.; ductility, high; weldability, good; brinell hardness, untreated, 217-241, heat treated, 600; for use in parts requiring high strength, guides, etc.

See advertisement, Page 249

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TOMBASIL—Ajax Metal Co., Philadelphia 23. Material available in two grades.

A; copper 81.5; silicon 4.8, zinc 13.7; in untreated state mechanical properties are: ult. tensile strength, 65,000 lb. per sq. in.; yield point, 40,000 lb. per sq. in.; elongation, 15.00 per cent; hardness, 140 brinell; specific gravity, 8.25; nonmagnetic; weldability, good.

Navy; analysis in accordance with Navy Dept. Spec. 46B28—copper 90, silicon 5 max., zinc 5; in untreated state, ult. tensile strength, 55,000 lb. per sq. in.; yield point, 20,000 lb. per sq. in.; elongation, 40.00 per cent; hardness, 105 brinell; specific gravity, 8.25; nonmagnetic; weldability, good.

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TONCAN IRON—Republic Steel Corp., Cleveland. An open-hearth iron alloyed with .4 min. copper and .07 min. molybdenum; resists corrosion caused by atmosphere, water, oils and process materials; tensile strength, 48-58,000 lb. per sq. in. min.; compressive strength 40,000; brinell hardness 90-120; for housing, piping, tubing, etc.

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TOOLWELD — Lincoln Electric Co., Cleveland.

Type 60; coated arc welding electrode, deposited hardness of 60-65 Rockwell C; hardness retained to 1000 degrees Fahr.; deposit can be heat treated same as high-speed steel; for building hard, tough cutting edges on cold-rolled steel and for other applications requiring super-hardness.

Type 55; for making metal-cutting edges where shock is encountered (for cutting tools, blades and dies) providing an as deposited weld metal hardness without heat-treatment of 55-60 Rockwell C. While not quite as hard as Type 60, it is somewhat tougher and more shock resistant. Otherwise, properties are essentially the same as type 60.

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TOPHET—Wilbur B. Driver Co., Newark, N. J.

Type A; approximately 80 per cent nickel and 20 chromium; resists heat to 2100 degrees Fahr.; supplied in wire and strip form for electrical heating applications.

Type C; nickel 60, chromium 15, and balance iron; resists heat to 1800 degrees Fahr.; supplied in wire and strip form; for electrical resistance and heating application.

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TRANSWELD—Lincoln Electric Co., Cleveland. Heavily-coated electrode of shielded arc type for welding of steel in all positions with A.C. current; tensile strength 80,000-85,000 lb. per sq. in.

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TRANTINYL—Youngstown Alloy Castings Corp., Youngstown, O. Furnished as sand castings. High abrasion resistance; medium ductility; high tensile strength; used for tools for tube and bar mills such as guide shoes, plugs, guides, etc.

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TRODALOY—General Electric Co., Schenectady, N. Y. Resistance welding electrode alloys available in two grades.

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No. 1; cobalt 2.6, beryllium .4, and copper 97; Me- has 55 per cent conductivity of copper. Mechanical properties in heat-treated state: ult.

1-Corrosion resistant | 2-Heat resistant | 3-Abrasion resistant | 4-High tensile strength | 5-High ductility | 6-Bearing application | 7-Electrical uses | 8-Heat treating | 9-Low specific gravity | 10-Machinability

tensile strength, 90-120,000 lb. per sq. in.; impact resistance, high; hardness, 220 brinell; for resistance welding electrodes, soldering iron tips, springs, bushings, castings, brake drums, etc. All sales made through following licensees: P. R. Mallory Co., Ampco Metal Co., Wilbur B. Driver Co., Electroloy Co. and Welding Sales & Engineering Co.

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No. 7; beryllium .1, chromium .4 and copper 99.5; furnished in rough bars or billets, finished rods or bars, wire, strips, plates for hot forging, stamping, extruding, turning, boring and as sand castings. Mechanical properties in heat-treated state: ult. tensile strength 45-70,000 lb. per sq. in.; impact resistance, high; endurance limit (completely reversed bending), 18-25,000 lb. per sq. in.; hardness, 90-140 brinell; nonmagnetic; used for resistance welding electrodes, high conductivity springs and castings, and substitute for P-bronzes.

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TRUALOY—True Alloys Inc., Detroit.

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Copper; has high conductivity; castings for welding machines and conduction of current.

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Bearing bronze; low friction and wear, with high compressive strength; resistant to pounding and easy to machine.

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Aluminum; castings possessing high tensile strength, hardness and lightness.

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Aluminum bronze; for sand castings having corrosion resistance and tensile strength of 65,000 lb. per sq. in.; recommended for parts subject to strain and wear.

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TRUFLEX Thermostat Metals — General Plate Div., of Metals and Controls Corp., Attleboro, Mass. Available in sheets or strips in long lengths, flattened and coiled, or cut to length—spiral, helix or double-helix coils—also fabricated parts, and welded or riveted sub-assemblies with solid-silver or laminated electrical contacts or mounting brackets. For control or indication of temperature and for compensating movement required in assemblies due to changes in temperature.

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TUBELOY—American Smelting & Refining Co., New York. Carbon .02, magnesium .02, tin .25, balance lead; tubing for extruding. Mechanical properties in untreated state: ult. tensile strength, 4500 lb. per sq. in.; elongation, 15 per cent; impact resistance, medium; endurance limit (completely reversed bending), 1500 lb. per sq. in.; brinell hardness number, 9; specific gravity, 11.33; weldability, fair; resists corrosion caused by water, gasoline, etc.; abrasion resistance, low; used for conveying water, oil and other types of liquids.

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TUFTEST—The Medart Co., St. Louis. Cast iron for parts subject to excessive abrasion such as grinding disks; machinability, good.

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U-LOY—Republic Steel Corp., Cleveland. Copper-bearing steel with good corrosion resistance, available in hot rolled and galvanized sheets.

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ULTRA-CUT—Bliss & Laughlin Inc., Buffalo, N. Y. High sulphur bessemer screw stock furnished in cold finished bars, for miscellaneous automatic screw machine parts.

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UNION — Union Drawn Steel Div., Republic Steel Corp., Massillon, O.

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Freecut; carbon .08-.13 max., manganese .6-.9, phosphorus .09-.13, sulphur .16-.23; a free-cutting bessemer type steel.

Supercut; high-sulphur bessemer type; carbon .08-.13 max., manganese .6-.9, phosphorus .09-.13, and sulphur .24-.33.

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U. S. S.—United States Steel Corp., subsidiaries, including American Steel & Wire Co., Carnegie-Illinois Steel Corp., Columbia Steel Co., National Tube Co., Tennessee Coal, Iron & Railroad Co., and Tubular Alloy Steel Corp.

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Type 302, U. S. S. 18-8; carbon .08-.2, chromium 17-20, nickel 7-10; resists heat to 1650 degrees Fahr., high abrasion resistance; atmospheric and acid resistant; tensile strength ult., 80-95,000 lb. per sq. in. annealed. 105-300,000 lb. per sq. in. in cold worked; high ductility; weldability, good; brinell hardness, annealed, 135-185; for food processing and chemical equipment, etc., fabricated by other than welding.

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Type 303, U. S. S. 18-8 F. M.; carbon .2, manganese 1.5, sulphur or selenium .07 min., molybdenum .6, silicon .75, chromium 17.5-20, nickel 8-10; resists heat to 1600 degrees Fahr.; high abrasion resistance; tensile strength, ult., 80-95,000 lb. per sq. in.; high ductility; brinell hardness, untreated, 135-220; for nuts, bolts, valve parts, and shafting.

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Type 304, U. S. S. 18-8-S; carbon .08 max., chromium 18-20, and nickel 8-10; similar to Type 302; abrasion-resistant; high ductility; used where corrosion resistance is desired after fabrication by welding.

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Type 309, U. S. S. 25-12; carbon .2, manganese 2, phosphorus .03, silicon .75, chromium 22-26, nickel 12-14. Corrosion and heat-resistant; high abrasion resistance; tensile strength, ult., 90-110,000 lb. per sq. in.; high ductility; brinell hardness, untreated, 150-185; for high temperature service, 2100 degrees Fahr. max.

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Type 316, U. S. S. 18-8 Mo.; carbon .1; manganese 2, phosphorus .03, silicon .75, chromium 16-18, nickel 10-14 max., molybdenum 2 to 3. Corrosion and heat-resistant; high abrasion resistance, tensile strength, ult., 80-95,000 lb. per sq. in.; high ductility for chemical and food equipment.

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Type 321, U. S. S. 18-8-Ti.; carbon .1 max., chromium 17-20, nickel 7-10, silicon .75, manganese 2, phosphorus .03, titanium four times actual carbon minimum; addition of titanium prevents susceptibility to intergranular corrosion. Tensile strength, 80-95,000 lb. per sq. in.; high ductility; abrasion-resistant; high temperature service and where welded parts are subject to corrosion.

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Type 347, U. S. S. 18-8 Cb.; carbon .1, chromium 17-20, nickel 8-12, manganese 2, phosphorus .03, silicon .75, columbium 10 times carbon min.; addition of columbium prevents susceptibility to intergranular corrosion; tensile strength, ult., 80-95,000 lb. per sq. in.; high abrasion resistance; for high temperature service and where welded parts are subject to corrosion.

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Type 410, U. S. S. 12; carbon .15, manganese .75, phosphorus .03, sulphur .03, silicon .75 max., chromium 10-14, corrosion and oxidation resistant; responds to heat treatment and can be modified by addition of columbium, aluminum and molybdenum for specific application; tensile strength, ult., 65-85,000 lb. per sq. in. annealed, 100-200 000 heat-treated; high ductility; high abrasion resistance; for turbine blading, shafting, valve parts, wire cable, screens, nuts and bolts.

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Type 416, U.S.S.-12 F.M.; carbon .15, manganese 1.25, phosphorus .04, sulphur or selenium .07 or molybdenum .6, silicon .75 max., chromium 12-14; similar to Type 410 except addition of sulphur, selenium or molybdenum increases the machinability; not to be used where welding is required; used for shafting, nuts, bolts, valve, trim and valve parts.

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Type 430, U.S.S.-17; carbon .12 max., manganese .75, phosphorus .03, sulphur .03, silicon .75, chromium 14-18, nickel .5; resists corrosion caused by nitric acid, atmosphere and industrial corrosives; resists heat to 1550 degrees Fahr.; medium abrasion resistance; tensile strength, ult., 70-90,000 lb. per sq. in.; used in nitric acid equipment, as screens, valves, shafting, nuts, bolts, rivets and plate construction.

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Type 446, U.S.S.-27; carbon .35, manganese 1, phosphorus .035, sulphur .035, silicon 1.5, chromium 23-30, nickel 1; resists heat to 2100 degrees Fahr.; medium abrasion resistance; tensile strength, ult., 75-95,000 lb. per sq. in.; for high temperature service, where resistance to sulphides and concentrated nitric acid is required.

Type 501, U.S.S.-5; carbon over .1 and chromium 4-6.

Type 502, U.S.S.-5-S; carbon .1 max., chromium 4-6; molybdenum .5 is added to increase creep strength and avoid temper brittleness; columbium is added to eliminate air hardening and increase oxidation resistance slightly.

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Shelby 5 per cent chrome-molybdenum tubing; used for furnace tubes in oil-cracking stills, condensers and superheaters where high temperatures and pressures, and corrosive fluids are handled; chromium .15 max., manganese .5 max., silicon .5 max., carbon 4-6, and molybdenum .45-.65.

Shelby tubing may be obtained in many additional grades from the lowest carbon boiler tube steel to the stainless grades of alloy steel which are available in tubing in all sizes up to 10¾ inches outside diameter. A number of steels made to S.A.E. standards are also furnished in Shelby tubing.

Castings furnished by Lorain Div.; Type A-1; carbon .3-.4, chromium .75-1, nickel 2.5-3, manganese .6-.8, and molybdenum .3-.4; Type A3; carbon .45-.55, chromium .75-.9, nickel .6-.8, manganese 1.5-2, and molybdenum .3-.4; and Type MS-1; carbon 1-14, chromium .75-1, manganese 10-14.

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Electrical steel sheets for use in transformers, motors and generators; eleven principal grades of electrical sheets furnished—U.S.S., Pole, Field, Armature, Electrical, Motor, Dynamo, Radio Transformer 72, and Transformer 72, 65, 58, and 52.

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Other materials are furnished as follows: Carnegie-Illinois Steel Corp., Columbia Steel Co., Tennessee Coal, Iron & Railroad Co., and United States Steel Supply So.; stainless steel in sheets, plates, shapes and bars; National Tube Co., and Tubular Alloy Steel Corp.; in pipe and tubular shape; and American Steel & Wire Co., in strip and wire forms.

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U.S.S. AR STEEL (Abrasion Resisting Steel)—Carnegie-Illinois Steel Corp., Pittsburgh; Columbia Steel Co., San Francisco; and Tennessee Coal, Iron & Railroad Co., Birmingham, Ala. Carbon .35-.5, manganese 1.5-2, phosphorus .05 max., sulphur .055 max., silicon .15-.3; furnished in bars, sheets, strip, plates and shapes; high abrasion resistance; brinell hardness 200-275 as rolled, heat treated 350-450. Used for wear resisting surfaces.

See advertisement, Page 120

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U.S.S. CARILLOY—Carnegie-Illinois Steel Corp., Pittsburgh. Alloy steels in all standard grades of S.A.E. steels sold under the above tradename.

See advertisement, Page 120

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U.S.S. COR-TEN—Carnegie-Illinois Steel Corp., Pittsburgh; Columbia Steel Co., San Francisco; and Tennessee Coal, Iron & Railroad Co., Birmingham, Ala. Carbon .12 max., manganese .1- .5 max., phosphorus .07-2, silicon .35-1, copper .3-.5, chromium .5-1.5; furnished in bars, sheets, strip, plates, structural and bar shapes, for hot and cold forming, welding, riveting, turning, etc. Resists atmospheric corrosion four to six times that of plain carbon steel; abrasion resistance, good; yield point 50,000 min.; tensile strength 70,000 min. lb. per sq. in., with exceptionally high ductility; bearing properties, good; weldability, good. Used for light-weight construction, where atmospheric corrosion resistance is a major factor.

See advertisement, Page 120

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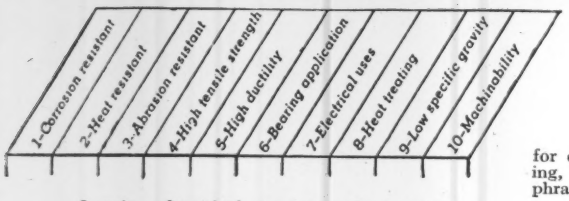
U.S.S. MAN-TEN—Carnegie-Illinois Steel Corp., Pittsburgh; Columbia Steel Co., San Francisco; and Tennessee Coal, Iron & Railroad Co., Birmingham, Ala. Carbon .3 max., manganese 1.1-1.6, phosphorus .04 max., sulphur .05 max., silicon .3 max., copper



.2 min.; furnished in bars, sheets, strip, plates, structural and bar shapes, for hot and cold forming, welding and riveting; corrosion-resistant; high abrasion resistance; yield point 50,000 min.; tensile strength 75,000 min. lb. per sq. in.; good ductility and weldability. Used for lightweight construction where atmospheric corrosion resistance is not a major factor.

See advertisement, Page 120

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UNIVAN—Union Steel Casting Co., Pittsburgh. Nickel-vanadium alloy; tensile strength 90,000 lb. per sq. in.; for locomotive frames, crossheads, coupling boxes, driving wheel centers, etc.

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VELVETOUCH—The S. K. Wellman Co., Cleveland, O. Friction materials consisting of a combination of various powdered metals such as copper, tin, lead and other powdered materials, compressed, sintered and welded to a solid metal backing for support. Applications include clutch and brake facings, clutch disks, thrust bearing steam seals, etc.

See advertisement, Page 217

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VIBRO-ISOLATOR—Korfund Co., Long Island City, N. Y. Coiled steel spring vibration isolator for absorbing shock and preventing vibration transmission. Isolators can be used with or without concrete foundations for stationary and marine installations.

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WEARWELD—Lincoln Electric Co., Cleveland; brinell hardness 488-548; suitable for hard-facing wearing surfaces subject to shocks and abrasion.

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WELLCAST—The Wellman Bronze & Aluminum Co., Cleveland.

17-S; High-strength, aluminum-silicon-titanium alloy, with high ductility; used in aircraft castings; tensile strength, 28,000-30,000 lb. per sq. in.

Magnesium; used for aircraft engine castings; tensile strength, 28,000 lb. per sq. in.; 42,000 lb. per sq. in. heat treated.

See advertisement, Page 233

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WESTERN—Western Cartridge Co., East Alton, Ill.

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Yellow brass; copper 66, zinc 34.

Deep drawing brass; copper 68, zinc 32.

Cartridge brass; copper 70, zinc 30.

Low brass; copper 80, zinc 20.

Rich low brass; copper 85, zinc 15.

Commercial bronze; copper 90, zinc 10.

Gilding metal; copper 95, zinc 5.

Sheet or strip in coils and lengths, annealed or rolled tempers. For drawing, forming and stampings.

Leaded yellow brass; copper 61-68, lead 1-4, zinc balance; sheet or strip, for blanking and machining.

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Phosphor bronze; copper 95, tin 5.

For springs; copper 92, tin 8; also for contacts, etc., requiring spring qualities combined with corrosion resistance and non-magnetic properties; in sheets or strip.

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Nickel-silver nickel 10-18, copper 55-70, balance zinc A white alloy used where corrosion resistance plus strength are prime requisites; supplied in wide ranges of temper for deep drawing, spinning, forming, blanking, high tensile strength for springs, diaphragms, etc.

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WILCO—H. A. Wilson Co., Newark, N. J.

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Contact materials; electrical; silver, platinum, tungsten and alloy contacts; silver-steel laminated contacts for projection welding; silver composite contacts; silver and platinum inlay and overlay on base metals. Furnished in sheet and wire.

Thermometal; thermostatic bimetals furnished in strips and formed parts for temperature control and compensation.

Precious metal collector rings for rotating controls.

Jacketed wire; silver on steel, copper, Invar, or other combinations requested.

See advertisement, Page 240

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WOLVERINE—Wolverine Tube Div., Detroit.

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Aluminum brass; copper 76, zinc 22, aluminum 2; furnished in tubing; corrosion-resistant; medium abrasion-resistant; tensile strength 52-100,000 lb. per sq. in.; for bushings, condenser tubing.

Phosphorus-bearing Admiralty brass; copper 70, zinc 29, tin 1, residual phosphorus .001-.1; furnished in tubing; medium abrasion resistance; tensile strength 48-90,000 lb. per sq. in.; for condenser tubing.

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Phosphorized arsenical Admiralty brass; copper 70, zinc 29, tin 1, phosphorus .015 max., arsenic .35 max.; furnished in tubing; corrosion-resistant; balance same as Admiralty.

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70-30 brass; copper 70, zinc 30; furnished in tubing; corrosion resistant; medium abrasion-resistant; tensile strength 48-88,000 lb. per sq. in.; used for condenser tubing.

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Red brass; copper 85, zinc 15; furnished in tubing; corrosion-resistant; medium abrasion resistance; tensile strength 40-69,000 lb. per sq. in.; high ductility; for condenser tubing.

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Common high-brass; copper 66, lead .65 max., zinc balance; furnished in tubing; corrosion resistance; medium abrasion resistance; tensile strength 48-85,000 lb. per sq. in.; for cupped, formed or drawn parts, etc.

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Copper, oxygen-free; copper and silver 99.9 min., phosphorus .015-.035 (optional as deoxidizer); furnished in tubing; corrosion-resistant; tensile strength 31-60,000 lb. per sq. in.; high ductility; for condensers, evaporators, heaters, condenser tubes, etc.

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Cupro-Nickel; copper 70, nickel 30; furnished in tubing; corrosion-resistant; medium abrasion resistance; tensile strength, 65,000-110,000 lb. per sq. in.; for condenser tubing.

Copper, arsenical; copper and silver 99.2 min.; phosphorus .015-.035, arsenic .15-.50; balance is the same as oxygen-free copper.

Commercial bronze; copper 90, zinc 10; furnished in tubing; corrosion-resistant; available in color; medium abrasive resistance; tensile strength 36-63,000 lb. per sq. in.; high ductility; for ornamental purposes.

Low brass; copper 80, zinc 20; furnished in tubing; resists corrosion; medium abrasive resistance; high ductility; tensile strength 43-78,000 lb. per sq. in.; for bellows, ornamental purposes and fabricated parts.

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High brass (2 & 1) ; free turning; copper 66, lead 1.75, zinc balance; furnished in tubing; corrosion-resistant; medium abrasion resistance; tensile strength 48-85,000 lb. per sq. in.; machinability; for screw machine parts and fabricated parts.

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Naval brass; copper 60, tin .75, zinc balance; furnished in tubing; corrosion and abrasion resistance; tensile strength 55-100,000 lb. per sq. in.; used where corrosion resistance with high strength is required.

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Muntz metal; copper 60, zinc 40, furnished in tubing; corrosion and abrasion resistance; tensile strength 48-85,000 lb. per sq. in.; for condenser tubes, etc.

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Aluminum 2S; aluminum 99; furnished in tubing; ductility good; tensile strength 13-24,000 lb. per sq. in.; machinability, poor; used for airplane parts, oil burners, etc., where light weight is important.

Aluminum 3S; aluminum 97, manganese 1.25; furnished in tubing; ductility, good; tensile strength 16-29,000 lb. per sq. in.; machinability, good; used for airplane parts, oil burners, etc., where light weight is desired.

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WORTHITE—Worthington Pump & Machinery Corp., Harrison, N. J. Nickel 24, chromium 20, molybdenum 3, silicon 3.5, carbon .07 max., other elements 2, balance iron; furnished in finished rods or bars and as sand and centrifugal castings for turning, boring, welding, etc.; corrosion-resistant; heat resistance 2000-2200 degrees Fahr.; high abrasion resistance; tensile strength 97,000 lb. per sq. in. hot rolled, 72,000; sand cast; medium ductility. Used for pumping equipment, valves, pipe fittings and special apparatus for corrosion resistance.

Y

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YOLOY—The Youngstown Sheet & Tube Co., Youngstown, O. Carbon .05-.35, manganese .3-1.2, nickel 1-2, copper .75-1.25; special service alloy steel furnished in rough bars or billets, finished rods or bars, tubing, wire, sheets, coiled strip, and plates, for hot forging, stamping, extruding and welding. Mechanical properties in untreated state: ult. tensile strength, 70,000 lb. per sq. in. and up, depending on carbon and manganese content; yield point, 50,000 lb. per sq. in. min.; impact resistance, high; hardness, 130 and up (brinell), depending on analysis; weldability, excellent; good machinability.

Z

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ZAMAK—New Jersey Zinc Co., New York. Zinc alloys for die cast parts.

No. 2; aluminum 4.1, copper 2.7, magnesium .03, remainder Horse Head Special zinc.

No. 3; aluminum 4.1, magnesium .04, remainder Horse Head Special zinc.

No. 5; aluminum 4.1, copper 1.0, magnesium .04, remainder Horse Head Special zinc.

See advertisement, Page 218

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ZILLOY—The New Jersey Zinc Co., New York. Rolled zinc alloys containing approximately 1 per cent copper. Furnished in sheets and strips for forming and stamping.

See advertisement, Page 218

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ZINCGRIP—American Rolling Mill Co., Middletown, O. Galvanized sheet iron or steel, in strips or coils, with unusual forming and drawing qualities; for use wherever severe forming makes ordinary galvanized sheet metal unsatisfactory.

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Hot and cold-rolled steels; obtainable in ARMCO ingot iron and ARMCO high-tensile steel, copper-bearing steel and varying analyses of medium and low carbon steel. Available in sheet form; for severe forming requirements.

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Long ternes; terne coated sheets with ingot iron, mild steel, or high-tensile steel base metal. For deep drawing requirements and paintability.

Spiral-welded pipe, in wall thicknesses of 7/64 to ½ inch, diameters 6 to 36 inches and lengths up to 50 feet; supplied mill coated, galvanized or bituminous coated and lined. Available standard or custombuilt fittings. Base metal mild or high tensile steel.

Producers of Iron, Steel and Nonferrous Metals

A

Acme Steel Co., 2840 Archer Ave., Chicago 8.
Colored strip steel—COLORSTRIP and SUPERSTRIP

Ajax Metal Co., 46 Richmond St., Philadelphia 23.
High tensile strength alloy—TOMBASIL
Gear bronze—AJAX-HAMILTON

Alan Wood Steel Co., Conshohocken, Pa.
High-strength steel — "AW" DYN-EL and DYN-EL
Rolled-steel floor plate—"AW"

Allegheny Ludlum Steel Corp., Brackenridge, Pa.
Stainless steels—ALLEGHENY METAL
Special alloy tool steels—ATLAS No. 93, PYTHON and SEMINOLE
Nondeforming tool steel—DEWARD
Carbon tool steel—POMPTON
Electrical steels — ALLEGHENY LUDLUM, MUMETAL, OHMALOY and SEALMET.
Mild and stainless steel—PLURAMELT
See advertisement, Page 235

Aluminum Co. of America, 634 Gulf Bldg., Pittsburgh.
Aluminum alloys—ALCOA
Aluminum casting alloys—LYNITE
Aluminum sheet—ALCLAD

Aluminum Industries Inc., 2438 Beekman St., Cincinnati.
Aluminum base alloys—PERMITE

American Agile Corp., 5806 Hough Ave., Cleveland.
Welding electrodes—AGILE-ACTARC
See advertisement, Page 242

American Brass Co., Waterbury, Conn.
Copper-aluminum alloy—AVIALITE
Copper, aluminum and nickel alloy—TEMPALOY
Corrosion resistant alloys—AMBRAC, TOBIN BRONZE, ANACONDA, EVERDUR
See advertisements, Pages 147-153

American Crucible Products Co., 1301 Oberlin Ave., Lorain, O.
Bearing bronze—PROMET

American Magnesium Corp., 2210 Harvard Ave., Cleveland.
Magnesium alloy—MAZLO
See advertisement, Page 118

American Manganese Steel Div., The American Brake Shoe Co., Chicago Heights, Ill.
Cast alloy steels and welding rods—AMSCO
Welding rod—MO-MANG

American Nickeloid Co., 23 Second St., Peru, Ill.
Prefinished bonded-sheet and strip—NICKELOID, CHROMALOID, BRASSOID; AMERICAN Bonded Metals, Copper Steel and Zinc-Plated Steel

American Rolling Mill Co., Middletown, O.
Stainless and high strength steels—ARMCO
high silicon steel and pure iron and ingot iron
Galvanized sheet iron or steel—ZINCGRIP and PAINTGRIP

American Smelting & Refining Co., Equitable Bldg., New York.
Cadmium-nickel bearing alloy—ASARCOLOY No. 7
Lead-bearing alloy—"G" ALLOY
Tubing—TUBELOY

American Steel & Wire Co., Rockefeller Bldg., Cleveland.
Carbon steels and alloys—AMERICAN QUALITY
Cold-finished steel bars—AMERCUT
Spring steel—PREMIER

Ampco Metal Inc., 1745 South 38th St., Milwaukee, 4.
Corrosion and shock-resistant alloys—AMPCO METAL
Coated welding rods—AMPCO-TRODE
Copper base alloys—AMPCOLOY
See advertisement, Page 137

Amplex Mfg. Co., Div. of Chrysler Corp., 6500 Harper Ave., Detroit.
(See Chrysler Corp.)

Anchor Drawn Steel Co., Latrobe, Pa.
High-carbon steel—RED ANCHOR

Apollo Metal Works, 6605 South Oak Park Ave., Chicago 38.
Prefinished cold-rolled steel, and zinc-steel—APOLLO

Apollo Steel Co., Apollo, Pa.
Copper-bearing steel—APOLLOY METAL

Aurora Metal Co., 614 West Park Ave., Aurora, Ill.
Aluminum-bronze alloy—AUROMET

B

Babcock & Wilcox Co., 85 Liberty St., New York.
Corrosion, wear and heat-resisting alloys—ADAMANTINE and ELVERITE

Babcock & Wilcox Tube Co., Beaver Falls, Pa.
Corrosion and heat-resisting steel tubes—B & W CROLOY
See advertisement, Page 245

Baker & Co. Inc., 113 Astor St., Newark 5, N. J.
Platinum alloy—BAKER and PLATINUM-CLAD

Bearium Metals Corp., 268 State St., Rochester, N. Y.
Bearing metal—BEARIUM METAL

Beckett Bronze Co., Muncie, Ind.
High-lead bronze—BECKETT METAL

Belle City Malleable Iron Co., Racine, Wis.
Pearlitic malleable iron—BELMALLOY
High-strength malleable iron—BELECTRO-MAL
Electric-furnace-melted cast iron—BELECTRIC

Beryllium Corp. of Penna., Reading, Penna.
Beryllium-copper—BERYLCO No. 25

Bethlehem Steel Co., Bethlehem, Pa.
Copper-bearing steel—BETH-CU-LOY
High-carbon, manganese and nickel steels; and chromium-molybdenum steel castings—BETHLEHEM
High-temperature alloy steel—SUPERTEMP
Nickel-chromium steels—MAYARI

Binney Castings Co., 2555 Dorr St., Toledo 7, O.
Heat-resisting castings—MIN-OX (Binney Metal) and BINNEY No. 71 and No. 73

Bliss & Laughlin Inc., P. O. Box 945, Buffalo, N. Y.
High-sulphur bessemer screw stock—ULTRA-CUT

Bohn Aluminum & Brass Corp., Lafayette Bldg., Detroit.
Light-aluminum alloy—BOHNALITE

Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.
Bearing bronzes—BOUND BROOK and COMPO
Porous iron bearing alloys—POWDIRON
See advertisement, Page 246

Bridgeport Brass Co., Bridgeport, Conn.
High-copper silicon bronzes—DURONZE
Copper and zinc alloys—BRIDGEPORT
Tubing—BRIDGEPORT

Buckeye Brass & Mfg. Co., 6410 Hawthorne, Cleveland.
Bearing bronzes—COMMERCIAL, HYSPEED and LUBRICO
See advertisement, Page 129

Buffalo Wire Works Co. Inc., 430 Terrace, Buffalo, N. Y.
Wire cloth—BUFFALO

Bunting Brass & Bronze Co., Spencer and Carlton Sts., Toledo, O.
Bearing bronzes—BUNTING
See advertisement, Page 220

Burgess-Parr Co., Freeport, Ill.
Acid-resisting alloy—ILLIUM

C

Cadman, A. W., Mfg. Co., 2816 Smallman St., Pittsburgh.
Nickel-bronze alloy—NICUITE
Babbitt metal—BEARITE and ACORN
Copper alloy—CUPALOY

Carboloy Co. Inc., 11177 East 8-Mile Rd., Detroit.
Cemented carbide—CARBOLOY

Carnegie-Illinois Steel Corp., Carnegie Bldg., Pittsburgh.
Abrasion-resisting steels—U.S.S. AR STEEL
Alloy steels—U.S.S. CARILLOY
Low-alloy, high-tensile steels—U.S.S. CORTEN and U.S.S. MAN-TEN
See advertisement, Page 120

Carpenter Steel Co., Reading, Pa.
Stainless and specialty alloy steels—CARPENTER
See advertisements, Pages 122-123

Cerro de Pasco Copper Corp., 40 Wall St., New York.
Bismuth-lead-tin-antimony castings — CERRO-MATRIX, CERROBASE and CERROBEND

Chace Co., W. M., 1614 Beard Ave., Detroit.
Thermostatic bimetals, and manganese alloys —CHACE

Chain Belt Co., 1604 W. Bruce St., Milwaukee.
High-tensile, corrosion-resistant castings—REX Z METAL

Chambersburg Engineering Co., Chambersburg, Pa.
Nickel-molybdenum-iron alloys—CECOLLOY and CECOLLOY IRON

Chase Brass & Copper Co., Waterbury 91, Conn.
Corrosion-resistant copper alloys—OLYMPIC BRONZE, ANTIMONIAL ADMIRALTY. CHAMET BRONZE, CHASE TELLURIUM COPPER and CHASE
Machinable bronze—TELNIC Bronze

Chicago Steel Foundry Co., Kedzie Ave. and 37th St., Chicago.
High tensile strength castings—EVANSTEEL and PYRASTEEL

Cleveland Tungsten Inc., 10200 Meech Ave., Cleveland.
Copper-tungsten electrodes—CLETALOY
Tungsten ground seal rod—CLEVE-TUNG

Cleveland Twist Drill Co., The, 1242 East 49th St., Cleveland 14.
High-speed steel—MO-MAX

Climax Molybdenum Co., 500 Fifth Ave., New York 18.
Molybdenum alloying element — MO-LYB-DEN-UM
See advertisement, Page 142

Cold Metal Products Co., The, Youngstown, O.
Carbon and alloy strip steel—CMP STRIP
See advertisement, Page 116

Columbia Steel & Shafting Co., Woodkrik St., Pittsburgh 30.
High-tensile steel—COLUMBIA

Continental Roll & Steel Foundry Co., East Chicago, Ind.
Hard alloys for rolls—DUQUESNE SPECIAL, CROMONITE, HUBBARD SPECIAL, CRASFLOY, CONTINENTAL Super Steel
Alloy cast steels—CONTINENTAL Alloy Steels

Chrysler Corp., Amplex Div., 6500 Harper Ave., Detroit.
Bearing bronze—OILITE
Machinery steel—AMOLA
Nonporous, High-density material — DAMASCITE

Cooper Alloy Foundry Co., 200 Bloy St., Hillside, N. J.
Alloy castings—COOPER ALLOYS

Copperweld Steel Co., Glassport, Pa.
Bearing alloy—ARISTOLOY
Copper-covered steel—COPPERWELD

Cramp Brass & Iron Foundries Div. Baldwin Locomotive Works, Philadelphia.
Copper alloys—CRAMP ALLOYS

Crucible Steel Casting Co., Almira Ave. and W. 84th St., Cleveland.
Sand castings—PAR

Crucible Steel Co. of America, 405 Lexington Ave., New York.
High-strength alloy steels—MAXEL
Corrosion and heat-resistant alloys—LO CRO and REZISTAL

D

Darwin & Milner Inc., 1260 West 4th St., Cleveland.
High-carbon, high-chrome steels—NEOR and COBALTCROM PRK-33

Dodge Steel Co., Tacony, Philadelphia 35.
Electric steel castings—DODGE
See advertisment, Page 124

Doehler Die Casting Co., 386 Fourth Ave., New York.
Copper-zinc-silicon alloys — DOLER-BRASS and DOLER-ZINK
Magnesium base alloys—DOLER-MAG
Aluminum base die castings—DOLER-ALUMIN

Dole Valve Co., The, 1901 Carroll Ave., Chicago.
Thermostatic bimetal—DOLE

Dow Chemical Co., Midland, Mich.
Magnesium and magnesium alloys—DOW-METAL

Driver-Harris Co., Harrison, N. J.
Corrosion, heat and wear resisting alloys — ADVANCE, NIREX, NILVAR, CHROMAX, CIMET, NICHROME, HYTEMCO, DRIVER-HARRIS 42 and 52 ALLOYS

Driver Co., Wilbur B., Riverside Ave., Newark, N. J.
Beryllium-copper alloys — BERALOY "A", CUPRON and TOPHET

Duraloy Co., Scottdale, Pa.
High-chrome, Iron and chrome-nickel alloys—DURALOY and DURASPUN

Duriron Co. Inc., Dayton, O. (and licensees—see Duriron in tradename listing).
Corrosion and heat-resistant alloys—ALCUMITE, DURICHLOR, DURIMET, DURIRON and DURCO

E

Eclipse Aviation Div., Bendix Aviation Corp., Philadelphia.
Seamless flexible metal hose—ECLIPSE

Electro-Alloys Co., Elyria, O.
Nickel-chromium—THERMALLOY

Electro Metallurgical Sales Corp., 30 East 42nd St., New York.
Ferro-alloy—ELECTROMET

Erie Malleable Iron Co., Erie, Pa.
Abrasion and wear-resisting cast products—ERMAL and ERMALITE

Eutectic Welding Alloys Inc., 40 Worth St., New York.
Welding alloys—CASTOLIN, COLDARC, COLDWELD, BRONZOCHROM and DURFACE.
See advertisement, Page 238

F

Fahralloy Co., Harvey, Ill.
High nickel-chrome—FAHRALLOY

Fansteel Metallurgical Corp., North Chicago, Ill.
Corrosion-resistant, high tensile strength metals—FANSTEEL

Farrell-Cheek Steel Co., Sandusky, O.
Abrasion-resisting cast steel—FARRELL

Federal Mogul Corp., 11031 Shoemaker Ave., Detroit.
Bearing bronzes—FEDERAL
Babbitt bearing alloys—MOGUL
Lead base babbitt—BERMAX BABBITT

Firth-Sterling Steel Co., McKeesport, Pa.
Sintered carbides—FIRTHITE and FIRTHALOY
Stainless steels, and chrome-nickels—STERLING

Foote Bros. Gear and Machine Corp., 5301 S. Western Blvd., Chicago.
Nickel-molybdenum alloy—FIVEPOINT DEEPHARD STEEL

Frank Foundries Corp., Moline, Ill.
Corrosion and abrasion-resistant alloys — FRANKITE

Frontier Bronze Corp., 818 Elmwood Ave., Niagara Falls, N. Y.
Heat and wear-resisting alloys—FRONTIER

G

General Electric Co., Schenectady, N. Y. (and licensees—see Alnico in tradename listing).
Magnet alloy—ALNICO
Welding electrodes—TRODALOY

General Plate Div., Metals & Controls Corp., Attleboro, Mass.
Thermostat metals—TRUFLEX

Gibson Electric Co., 585 Blvd. of the Allies, Pittsburgh.
Electrical contact materials—GIBSILOY
See advertisement, Page 236

Globe Steel Tubes Co., Milwaukee.
Seamless steel tubing—GLOBE
See advertisement, Page 232

Great Lakes Steel Corp., Div. of National Steel Corp., Ecorse, Detroit, Mich.
High tensile alloy—N-A-X

Gunite Foundries Corp., Rockford, Ill.
Processed high-test cast iron—GUNITE

H

Handy & Harman, 82 Fulton St., New York 7.
Brazing alloys — HANDY FLUX, SILFOS, and EASY-FLO

Hardy Inc., Charles, 415 Lexington Ave., New York.
Powdered metal—HARDY POWDERS

Haynes Stellite Co., Kokomo, Ind.
Heat, corrosion and abrasion-resistant cobalt-chromium-tungsten—STELLITE
Abrasion-resistant tungsten-carbide diamond substitute—HAYSTELLITE
Impact-resistant, iron-base, hard-facing rod—HASCROME

Heppenstall Co., Hatfield St., Pittsburgh.
Abrasion-resistant alloy steels — HARDTEM and KLEENKUT
High-strength alloy steel HEPPENSTALL and EIS-45
Nickel-chrome-molybdenum steel—EIS-57

Hills-McCanna Co., 2349 Nelson St., Chicago.
Magnesium alloy sand castings—HILLS-MCCANNA
See advertisement, Page 144

Hoskins Mfg. Co., 4445 Lawton Ave., Detroit.
Heating element alloys—CHROMEL and COPEL

Howard Foundry Co., Magnesium Div., Chicago.
High tensile strength alloy—FLYLIGHT
See advertisement, Page 223

I

Indium Corp. of America, 805 Watson Place, Utica, N. Y
Lead-silver solder—INDIUM
See advertisement, Page 238

Ingersoll Steel & Disc Division, Borg-Warner Corp., 310 S. Michigan Ave., Chicago.
Stainless-clad steel—INGACLAD
Stainless steel—INGERSOLL

International Nickel Co. Inc., 67 Wall St., New York (and licensees).
Corrosion, heat and wear-resisting alloys—NI-TENSYLIRON, NI-HARD, NI-RESIST, INTERNATIONAL, NICKEL, MONEL and INCONEL
See advertisements, Pages, 121, 216

J

Jeffrey Mfg. Co., The, First Ave. and Big Four railroad, Columbus, O.
High-strength malleable irons—PERDURO and SUPERMAL

Jessop Steel Co., Washington, Pa.
Nonmagnetic and stainless steels—JESSOP
Stainless steels — DURO-GLOSS, HI-GLOSS and STA-GLOS

Johnson Bronze Co., New Castle, Pa.
Bearing metals — JOHNSON, LEDALOYL and JSB
See advertisement, Page 215

Jones & Laughlin Steel Corp., Jones & Laughlin Bldg., Pittsburgh.
Free-machining steel—JALCASE
Forging steel—J & L CORRECT BALANCE

K

Kennametal Inc., 1 Lloyd Ave., Latrobe, Pa.
Carbide alloys—KENNAMETAL
See advertisement, Page 226

Keystone Carbon Co., Saint Marys, Pa.
Self-lubricating porous bronze—SELFLUBE

Koppers Co., Bartlett-Hayward Div., Baltimore
Bronze alloy—D-H-S BRONZE

Korfund Co., Long Island City, N. Y.
Coiled steel spring vibration isolator—VIBRO ISOLATOR

L

Lake City Malleable Co., 5060 Lakeside Ave., Cleveland.
Malleable iron—SHOCK PROOF
See advertisement, Page 254

La Salle Steel Co., 150th and Magnolia, Hammond, Ind.
High-tensile alloy—STRESSPROOF

Lebanon Steel Foundry, Lebanon, Pa.
Alloy cast steels—CIRCLE L
See advertisement, Page 127

Lincoln Electric Co., 12818 Coit Rd., Cleveland.
High tensile welding rods — SHIELDARC, LIGHTWELD, MANGANWELD, WEARWELD, HARDWELD, ABRASOWELD, TOOLWELD, AERISWELD, FLEETWELD, STAINWELD, CHROMEWELD, FERROWELD, SOFTWELD, ALUMINWELD, READYWELD, SURFACEWELD, NICKEL-CHROMEWELD, PLANEWELD, TRANSWELD and FACEWELD

Linde Air Products Co., The, 30 E. 42nd St., New York.
Welding rods—OXWELD

Link-Belt Co., 220 S. Belmont Ave., Indianapolis.
Malleable cast iron—PROMAL

Lukens Steel Co., Coatesville, Pa.
Various types of steels—LUKENS

Lumen Bearing Co., 197 Lathrop Ave., Buffalo.
Wear-resisting—MACHINEBRONZE
High-tin babbitt—STANNUM BABBITT
Lead base bearing babbitt—LOTUS BABBITT
Bearing alloys—LUMEN ALLOYS

M

Mackintosh-Hemphill Co., 901 Bingham St., Pittsburgh.
Cast iron—IRALITE
High tensile strength metal—MACHEMPITE

Manganese Steel Forge Co., Allen St. and Butler Ave., Philadelphia.
Forged alloy steel—ROL-MAN

Magnolia Metal Co., Elizabeth, N. J.
Babbitt metal—MAGNOLIA
Antifriction metal—ADAMANT SUPER-GENUINE BABBITT, DEFENDER and PYRAMID METAL
Bearing Bronzes—MAGNOLIA Isotropic.

Magnus Metal Corp., 80 Jackson Blvd., Chicago (also 111 Broadway, New York)
Lead base alloy—SATCO Bearing Metal

Mallory, P. R., & Co. Inc., Indianapolis.
Welding electrodes—ELKALOY
Wear-resistant alloy—ELKONITE
Copper base alloys—MALLORY
Electrical contacts—ELKONIUM

Massillon Steel Castings Co., Massillon, O.
Alloy cast steel—TIGERLOY
Nitriding steel—NITRALLOY

McGill Mfg. Co., Valparaiso, Ind.
Corrosion-resistant alloys—McGILL

Medart Co., 3500 DeKalb St., St. Louis
High tensile strength cast iron—HITEST
Abrasion-resistant cast iron—TUFTEST
Alloy steel forgings—SMAVROC

Meehanite Metal Corp., Pershing Bldg., New Rochelle N. Y. (and licensees—see Meehanite in tradename listing).
Wear, heat and corrosion-resistant metals—MEEHANITE
See advertisement, Page 125

Metal Carbides Corp., Youngstown, O.
Tungsten-carbide metal—TALIDE

Metals Disintegrating Co. Inc., Elizabeth, N. J.
Powder metal—MD Metal Powders

Metals Refining Co., Hammond, Ind.
Powder metal—MIRCO METAL POWDER

Metal & Thermit Corp., 120 Broadway, New York.
Welding electrodes—MUREX

Michigan Seamless Tube Co., South Lyon, Mich.
Seamless tubing—MICHIGAN
See advertisement, Page 241

Molybdenum Corp. of America, Grant Bldg., Pittsburgh.
Alloying elements—MCA Molybdenum and MCA Ferro-Boron
See advertisement, Page 230

Monarch Steel Co., Indianapolis. (also affiliated company, **W. J. Holliday & Co., Hammond, Ind.**)
Low-carbon open-hearth steel—SPEED CASE
Medium-carbon open-hearth steel—SPEED TREAT

Moraine Products Div., General Motors Corp., 1340 Wisconsin Blvd., Dayton, O.
Bearing alloys—DUREX, MORAINE
Powder metal—POREX

Morganite Brush Co. Inc., 3302 48th Ave., Long Island City, N. Y.
Carbon-graphite-metal—MORGANITE
See advertisement, Page 145

Mueller Brass Co., Port Huron, Mich.
Bearing alloy—MUELLER 600 Bearing Metal

N

National Alloy Steel Division, Blawnox, Pa.
Corrosion-resisting castings—NA, NA-1, NA-2

National Bronze & Aluminum Foundry Co., E. 93d and Laisy Ave., Cleveland.
Aluminum castings—TENUAL

National Erie Corp., Erie, Pa.
Steel castings—NELOY

National Lead Co., 111 Broadway, New York 6.
Babbitt metal—DUTCH BOY BABBITT and HOYT BABBITT

National Malleable & Steel Castings Co., 10600 Quincy Ave., Cleveland.
Alloy cast steel—NACO
Malleable cast iron—MALLIX
Chromium-manganese-carbon alloy—NUREX
High-strength steel —NATIONAL Graphitic Steel

National Molded Products Inc., 122 Mill St., St. Marys, Pa.
Powder metal—NATIONAL

New Jersey Zinc Co., 160 Front St., New York,
Zinc alloy—ZAMAK and ZILLOY
See advertisement, Page 218

Ney Co., The J. M., 71 Elm St., Hartford, Conn.
Corrosion-resistant alloys—PALINEY and NEY-ORO G

Nitralloy Corp., The, 230 Park Ave., New York
(licensees—see Nitralloy in tradename listing).
Nitriding steel—NITRALLOY
See advertisement, Page 130

O

Ohio Seamless Tube Co., Shelby, O.,
Precision tubing—OSTUCO
See advertisement, Page 136

Ohio Steel Foundry Co., The, Lima, O.
Corrosion-heat-resistant materials—FAHRITE

P

Penn Brass & Copper Co., Erie, Pa.
Seamless brass and copper tubing—SUPERIOR

Phosphor Bronze Smelting Co., 2216 Washington Ave., Philadelphia.
Phosphor bronze—ELEPHANT BRAND

Pittsburgh Steel Co., Grant Bldg., Pittsburgh.
Stainless steels—PITTSBURGH STAINLESS

Potts Co., Horace T., E. Erie Ave. and D St., Philadelphia.
Chrome-nickel-molybdenum alloy—ELASTUF CHRO MOLY
Manganese type steel—ELASTUF PENN and STRAINFREE ELASTUF PENN

Precision Castings Co., Inc., Syracuse, New York.
Aluminum and zinc base alloys—PRECISION
Magnesium die castings—M-13

Precision Tube Co., 3824 Terrace St., Philadelphia.
Seamless tubing—PRECISION

R

Randall Graphite Products Corp., 609 W. Lake St., Chicago.
Graphite bronze bearings and bushings— RANDALL

Republic Steel Corp., Republic Bldg., Cleveland.
Open-hearth iron alloy—TONCAN IRON
Stainless and heat-resisting alloys—ENDURO
High-strength alloy—REPUBLIC
Enameling stock—TONCAN IRON
Copper-bearing steel—U-LOY

Revere Copper & Brass Inc., 230 Park Ave., New York 17.
Nonmagnetic corrosion-resistant, silicon bronze —HERCULOY
Bearing bronze—ROMAN BRONZE
Condenser tubes and plates, REVALON and REVERE CUPRO-NICKEL, 30 per cent

Rhoades, R. W., Metaline Co. Inc., P. O. Box No. 1, Long Island City, N. Y.
Heat-resisting bearing bronze—METALINE

Riverside Metal Co., Riverside, N. J.
Phosphor bronze, nickel silver and beryllium copper—RIVERSIDE
See advertisement, Page 243

Rustless Iron & Steel Corp., 3400 E. Chase St., Baltimore.
Chromium and chromium-nickel stainless steels—DEFIRUST, DEFIHEAT, DEFISTAIN, RUSTLESS and RUSTLESS 17
Hardening-type stainless steel—RUSTLESS
See advertisement, Page 131

Ryerson, Jos. T., & Son Inc., 16th and Rockwell St., Chicago.
Specially processed lead base alloys—GLYCO BABBITT
See advertisement, Page 236

S

Saginaw Bearing Co., Saginaw, Mich.
Bearing bronzes—SABECO and AGRICOLA
See advertisement, Page 114

Saginaw Malleable Iron Div., Saginaw, Mich.
Casting alloys—ARMASTEEL

Sandusky Foundry & Machine Co., Sandusky, O.
Nickel-chromium and molybdenum cast iron alloys—SANDUSKY ALLOY IRON
Bronze, brass and manganese bronze alloys—SANDUSKY BRONZES

Scovill Mfg. Co., Waterbury, Conn.
High and low brasses, phosphor-bronzes, nickel-silvers, cupro-nickels, etc.—SCOVILL
Spring material—OREIDE

Sharon Steel Co., Sharon, Penna.
Stainless and heat-resisting alloy—SHARON

Shenango-Penn Mold Co., Dover, O.
High-strength alloys—SHENANGO-PENN
See advertisement, Page 236

Steel & Tubes Division, Republic Steel Corp., Cleveland.
Steel and ferrous alloy tubing—ELECTRUNITE

Stoody Co., Whittier, Calif.
Hard-facing welding rods—SILFRAM, STOODEX, STOODY, STOODITE, BOROD and STOODY TUBE BORIUM

Sumet Corp., 1543 Filmore Ave., Buffalo.
Bronze bearings—SUMET

Summerill Tubing Co., Bridgeport, Montgomery Co., Pa.
Seamless tubing—SUMMERILL

Superior Metal Co., 6651 S. Oak Park Ave., Chicago 38.
Cold-rolled strip steel—SUPERIOR

Superior Steel Corp., Carnegie, Pa.
Stainless strip steel—SUPERIOR STAINLESS
Steel clad metal—SUVENEER
See advertisement, Page 219

T

Talon Inc., Steel Tube Div., Oil City, Pa.
Welded carbon steel—TALON

Taylor-Wharton Iron & Steel Co., High Bridge, N. J.
Corrosion and abrasion-resistant alloys—TISCO
Austenitic wear-resisting steel—TIMANG

Taylor-Wilson Mfg. Co., Thompson Ave., McKees Rocks, Pa.
Iron base casting—TAWILCO

Thomas Steel Co., Warren, O.
Cold-rolled strip steel—THOMASTRIP

Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O.
Abrasion-resistant bearing alloys—GRAPH-SIL, GRAPH-MO and GRAPH-M.N.S.
Creep-resisting alloy steels—DM STEEL, DM-45, SICROMO STEEL
Corrosion and heat-resistant alloys—SILMO, TIMKEN

Titanium Alloy Mfg. Co., Niagara Falls, N. Y.
Extra low carbon trimming steel—TAMCO

True Alloys Inc., 284 S. Summit, Detroit.
Aluminum-bronze alloys—TRUALOY

U

Unitcast Corp., Steel Casting Div., Toledo, O.
Alloy and carbon electric steel castings—TOLEDO ALLOY
See advertisement, Page 249

Union Drawn Steel Div., Republic Steel Corp., Massillon, O.
Cold-drawn steels—UNION

Union Steel Casting Division, 62nd and Butler Sts., Pittsburgh.
Nickel-vanadium steel—UNIVAN

United States Graphite Co., Saginaw, Mich.
Porous metal—GRAMIX
See advertisement, Page 156

United States Steel Corp., 436 Seventh Ave. Pittsburgh.
(See also American Steel & Wire Co., and Carnegie-Illinois Steel Corp.)
Stainless steels, Shelby and National tubing, castings, electrical steel sheets, copper steel sheets—USS
High-tensile low alloy steels—USS CORTEN and USS MAN-TEN
Alloy steels—USS CARILLOY
Abrasion-resistant steels—USS AR STEEL

W

Wall-Colmonoy Corp., 720 Fisher Bldg., Detroit.
Welding rods—COLMONOY

Wellman Bronze & Aluminum Co., 6017 Superior Ave., Cleveland.
Copper-tin-zinc-lead alloys—IDEALOY and ANFRILOY
Aluminum-silicon-titanium alloy—WELLCAST
See advertisement, Page 233

Wellman, S. K., The, 1374 E. 51st St., Cleveland.
Friction material—VELVETOUCH
See advertisement, Page 217

Western Cartridge Co., East Alton, Ill.
Brasses, phosphor bronzes and nickel silvers—WESTERN

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Corrosion and heat-resisting alloy—KONAL, PHOS-COPPER, K-42-B
Magnetic alloy—HIPERNIK
Gas type metal—KOVAR
Copper base alloy—CUPALOY
Iron-cobalt-alloy—CUFERCO

Wheelock, Lovejoy & Co. Inc., 128 Sidney St., Cambridge, Mass.
Machinery steels—ECONOMO, HYTEN

Wilson Co., H. A., 105 Chestnut St., Newark, N. J.
Contact and thermostatic metals—WILCO
See advertisement, Page 240

Wolverine Tube Div., 1411 Central Ave., Detroit.
Tubing—WOLVERINE

Worthington Pump & Machinery Corp., Harrison, N. J.
Corrosion and abrasion-resistant alloy — WORTHITE

Y

Youngstown Alloy Castings Corp., Youngstown, O.
High tensile strength alloy—TRANTINYL

Youngstown Sheet & Tube Co., Youngstown, O.
High strength alloy steel—YOLOY

Index of Alloys by Principal Constituents

OFTEN the engineer responsible for design selects the material for a machine part according to the base metal and certain alloying elements which are known to influence the properties in a desired direction. To provide the designer with a key between alloying constituents and tradenames the accompanying cross-reference index has been compiled. Further information on each alloy may be obtained by referring to the alphabetical listing by tradenames under "metals", commencing on Page 158.

Tradenamed alloys are indexed primarily under the base metal or predominating element or, in some cases such as bearing metals, under the primary use. Alloying elements which control the properties of the material are arranged alphabetically as subheads under the main heads. In a few cases additional controlling elements are added in italics.

IRON AND STEEL

Cr.
- B & W Croloy
- Bethlehem
- Carpenter
- Chromeweld 4-6
- Circle L
- Defiheat
- Defirust
- Duro-Gloss
- Eis 45
- Enduro
- Globe
- Ingersoll
- Kleenkut
- Lo-Cro
- Neor
- Ohmaloy (*Al*)
- Pittsburgh Stainless
- Rezistal
- Rustless
- Sealmet
- Sta-Gloss
- Sterling
- Summerill
- Superior
- Tempaloy
- U. S. S.
- U. S. S. Cor-Ten

Cr-Mo
- Amsco
- Atlas No. 93
- B & W Croloy
- Bethlehem 88-80
- Cecolloy
- Circle L
- Cobaltcrom-PRK-33
- Cro-Mol
- DM-45
- DM Steel
- Electrunite
- Farrell's 85
- Hardtem (*V*)
- Heppenstall 5H50 (*V*)
- Nitralloy (*Al*)
- Pyrasteel (*Si*)

Cr-Mo-Ni
- Par
- Sicromo (*Si*)
- Summerill
- Superior
- Timken
- Tisco
- U. S. S.

Cr-Ni
- Allegheny Metals
- Amsco
- Apollo Chromsteel
- Armco
- B & W Croloy
- Carpenter
- Chromel
- Circle L
- Defistain
- Duraloy
- Durco
- Durimet
- Electrunite
- Enduro
- Evansteel
- Fahralloy
- Fahrite
- Frankite
- Hi-Gloss
- Hubbard Special
- Ingaclad
- Jessop
- Mayari
- Mumetal (*Cu*)
- NA, NA-1, NA-2
- Ni-Hard
- Par
- Pittsburgh Stainless
- Pyrasteel
- Rezistal
- Rustless
- Sharon
- Silfram
- Summerill
- Superior
- Timken
- Tisco
- U. S. S.

Cr-Mn
- Adamantine
- Circle L
- Continental Super Steel
- Duquesne Special
- Eis 57
- Elastuff Chro-Moly
- Fivepoint Deephard Steel
- Heppenstall 2 C 30
- Hy-Ten (*Mo*)
- Lukens
- Nurex
- Stoody
- Supertemp
- Timken
- Tisco
- Worthite

Cr-V-W
- Mo-Max (*Mo*)
- Seminole

Cu
- Beth-Cu-Loy
- Copperweld
- U-Loy
- Yoloy (*Ni*)

Mn
- Amsco
- Apolloy Metal (*Cu*)
- Circle L
- Naco
- Rol-Man
- Strainfree Elastuf
- Stressproof
- Tisco
- Toledo Alloy (*V*)
- U. S. S. Man-Ten

Mn-Mo
- Amola
- Circle L
- Continental
- Deward
- Lukens
- MacHempIte
- Max-El
- Mo-Mang

Mn-Ni
- Allegheny Ludlum
- Amsco
- Continental
- Timang

Mn-Si
- Armasteel
- Bethlehem
- Carpenter
- Cecolloy Iron
- Columbia
- Graph-Sil
- N-A-X High Tensile
- Speed Case
- Speed Treat

Mo
- Circle L
- Economo
- Lukens
- Timken
- U. S. S.

Mo-Ni
- Bethlehem
- Cecolloy
- Circle L
- Continental
- Fivepoint Deephard
- Tigerloy

Ni
- Allegheny Ludlum
- Alnico (*AlCo*)
- Carpenter
- Graph-M.N.S. (*SiMoCrMn*)
- Hytemco
- Kovar (*Co*)
- Lukens
- Ni-Resist (*CuCrSiMn*)
- Ni-Tensyliron
- Yoloy (*Cu*)

S
- Ultra-Cut
- Union

Mo-Si
- Durichlor
- Graph-Mo
- Silmo
- Toledo Alloy

Si
- Allegheny Ludlum
- Armco
- Duriron

Other Alloy Steels
- Dodge
- J & L
- Neloy
- Nirex
- Python (*V*)
- Republic
- Smavroc
- Tamco (*Ti*)

Alloy Cast Iron
- Cecolloy
- Cimet
- Crasfloy
- Elverite
- Frankite
- Gunite
- Hitest
- Iralite
- Meehanite
- Ni-Hard
- Ni-Resist
- Ni-Tensyliron
- Sandusky Alloy Iron
- Shenango-Penn
- Tawilco
- Tuftest

Malleable Iron
- Belectric
- Belectromal
- Belmalloy
- Ermal
- Ermalite
- Mallix
- Perduro
- Promal
- Shockproof
- Supermal

Special Steels (not otherwise classified)
- American Quality
- Aristoloy
- AW
- AW Dyn-El
- Binney Metal
- CMP Strip
- Colorstrip
- Cooper Alloys
- Damascite
- Dyn-El
- Elastuf Penn
- Electromet
- Farrell's Hard Edge
- National Graphitic Steel
- Ostuco
- Pluramelt
- Pompton
- Premier
- Red Anchor
- Rex Z Metal
- Stoodex
- Stoodite
- Superior
- Superstrip
- Talon
- Thomastrip
- Vibro-Isolator
- Zincgrip

Iron
- Armco
- Toncan Iron

ALUMINUM BASE

Al and Al Alloys
- Alclad
- Alcoa
- Bohnalite
- Doler-Alumin
- Lynite
- Permite
- Precision
- Tamco
- Tenual
- Trualoy
- Wellcast
- Wolverine

BEARING METALS

Babbitt
- Acorn
- Adamant Super-Genuine
- Bearite
- Bermax
- Bunting
- Defender Metal
- Dutch Boy
- Glyyco Babbitt
- Hoyt Babbitt
- Johnson
- Lotus Babbitt
- Lumen Alloys
- Magnolia
- Mogul Babbitt
- Pyramid Metal
- Stannum Babbitt

Other Bearing Metals
- Agricola
- Anfriloy
- Asarcoloy
- Beckett Metal
- Bound Brook
- Bunting
- Commercial
- Compo
- Cramp Alloys
- Durex
- Federal Bronzes
- G Alloy
- Gramix
- Hy-Speed
- Idealoy
- JSB
- Johnson
- Ledaloyl
- Lubrico
- Lumen Alloys
- Machine Bronze
- Magnolia
- Metaline
- Moraine
- Mueller 600
- Oilite
- Porex
- Powdiron
- Promet
- Randall
- Sabeco
- Satco
- Selflube
- Sumet
- Trualoy

BIMETALS

- Chace Thermostatic
- Dole Thermostatic
- Truflex
- Velvetouch
- Wilco Thermometal

BONDED OR PLATED

- American
- Apollo
- Nickeloid
- Paintgrip
- SuVeneer

CARBON BASE

- Morganite

COBALT BASE

- Kennametal

BISMUTH BASE

Bi and Bi Alloys
- Cerrobase
- Cerrobend
- Cerromatrix

COPPER BASE

High Copper
- Anaconda
- Bridgeport
- Elkaloy
- Elkonite
- Mallory
- Phos-Copper
- Trualoy
- Wolverine

Cu-Ag
- Cupaloy
- Sil-Fos
- Wolverine

Cu-Al
- Avialite
- Frontier
- Lumen Alloys
- McGill
- Tempaloy
- Trualoy

Cu-Al-Fe
- Alcumite
- Ampcoloy
- Ampco Metal
- Ampco-Trode

Cu-Be
- Anaconda
- Beraloy "A"
- Berylco No. 25

Cu-Ni
- Advance
- Ajax-Hamilton
- Ambrac
- Anaconda
- Bridgeport Tubing
- Chase
- Copel
- Cupron
- Frontier
- Lumen Alloys
- Nicuite
- Revere Cupro-Nickel
- Summerill
- Western

Cu-Pb-Zn
- Chase
- Scovill Free-Cutting Brass
- Scovill Hardware Bronze
- Wolverine

Cu-Si
- Auromet
- Bridgeport Tubing
- Duronze
- Everdur
- Herculoy
- McGill
- Olympic Bronze

Cu-Sn
- Anaconda
- Bearium Metal
- Bridgeport
- Eclipse
- Elephant Brand
- Frontier
- Lumen Alloys
- Sandusky Bronzes
- Shenango-Penn
- Telnic Bronze
- Western

Cu-Sn-Zn
- Antimonial Admiralty (*Sb*)
- Bridgeport Tubing
- Chamet Bronze
- Oreide
- Roman Bronze
- Scovill
- Scovill Naval Brass
- Tobin Bronze
- Wolverine

Cu-Zn
- Anaconda
- Bridgeport
- Bridgeport Tubing
- D-H-S Bronze (*AlFeMn*)
- Doler-Brass
- Lumen Alloys
- Mueller 600 Bronze
- Revalon (*Al*)
- Sandusky Bronzes
- Tombasil (*Si*)
- Western
- Wolverine

Other Cu Alloys
- Bronzochrom
- Chase Tellurium Copper
- Cuferco (*FeCo*)
- Cupaloy (*AgCr*)
- Sil-Fos (*AgP*)
- Wolverine

ELECTRODES

- Abrasoweld
- Aerisweld
- Agile
- Aluminweld
- Castolin
- Chromeweld 4-6
- Cletaloy
- Coldarc
- Coldweld
- Colmonoy
- Durface
- Faceweld
- Ferroweld
- Fleetweld
- Hardweld
- Hascrome
- Lightweld
- Manganweld
- Murex
- Nickelchromeweld
- Oxweld
- Planeweld
- Readyweld
- Shieldarc
- Softweld
- Stainweld
- Surfaceweld (powder)
- Toolweld
- Transweld
- Trodaloy
- Wearweld

LEAD BASE

Pb and Pb Alloys
- Indium
- Tubeloy

MAGNESIUM BASE

Mg and Mg Alloys
- Doler-Mag
- Dowmetal
- Flylight
- Hills-McCanna
- M-18
- Mazlo

MOLYBDENUM BASE

Mo and Mo Alloys
- Fansteel Molybdenum
- MCA Molybdenum
- Tamco

NICKEL BASE

Ni and Ni Alloys
- Chromax
- Chromel (*Cr*)
- Driver-Harris
- Hastelloy
- Hipernik (*FeMn*)
- Illium (*Cr*)
- Inconel (*Cr*)
- International
- K-42-B (*Co*)
- Konal (*Co*)
- Monel (*Cu*)
- Nichrome
- Nilvar
- Shenango-Penn (*Cu*
- Tamco
- Thermalloy
- Tophet

PLATINUM BASE

Pt and Pt Alloys
- Baker
- Elkonium
- Nev-Oro G (*Au*)
- Paliney (*Pb*)
- Platinum-Clad
- Wilco

POWDER METAL

- Durex
- Hardy Powders
- MD Metal Powders
- MRCO Metal Powder
- National
- Porex

SILVER BASE

Ag and Ag Alloys
- Easy-Flo
- Elkonium
- Gibsiloy
- Handy Flux
- Wilco Contact Materials

TANTALUM

- Fansteel Tantalum

TITANIUM

- Tamco

TUNGSTEN BASE

W
- Cleve-Tung
- Fansteel Tungsten
- Mallory

W-Ag
- Cletaloy
- Wilco (*Pt*)

W-C
- Borod
- Carboloy
- Firthaloy
- Firthite (*Co*)
- Haystellite
- Stellite
- Talide

W-Cu
- Cletaloy

ZINC BASE

Zn and Zn Alloys
- Brassoid
- Chromaloid
- Doler-Zink
- Nickeloid
- Precision
- Zamak
- Zilloy

New Standard Steel Classifications

	SAE No.	AISI or NE No.	Chemical Composition Limits, Per Cent C	Mn	P(max.)	S(max.)	Si	Ni	Cr	Mo	Low Alloy Alternatives
Carbon Steels	1008	C 1008	.10 max.	.30- .50	.040	.050	.....	.....	.....	.....	.....
	1010	C 1010	.08-.13	.30- .50	.040	.050	.....	.....	.....	.....	.....
	1015	C 1015	.13-.18	.30- .50	.040	.050	.....	.....	.....	.....	.....
	1016	C 1016	.13-.18	.60- .90	.040	.050	.....	.....	.....	.....	.....
	1020	C 1020	.18-.23	.30- .50	.040	.050	.....	.....	.....	.....	.....
	1022	C-1022	.18-.23	.70-1.00	.040	.050	.....	.....	.....	.....	.....
	1024	C 1024	.20-.26	1.35-1.65	.040	.050	.....	.....	.....	.....	.....
	1025	C 1025	.22-.28	.30- .50	.040	.050	.....	.....	.....	.....	.....
	1030	C 1030	.28-.34	.60- .90	.040	.050	.....	.....	.....	.....	.....
	1035	C 1035	.32-.38	.60- .90	.040	.050	.....				
	1036	C 1036	.32-.39	1.20-1.50	.040	.050	.....				
	1040	C 1040	.37-.44	.60- .90	.040	.050	.....				
	1045	C 1045	.43-.50	.60- .90	.040	.050	.....				
	1050	C 1050	.48-.55	.60- .90	.040	.050	.....				
	1052	C 1052	.47-.55	1.20-1.50	.040	.050	.....				
	1055	C 1055	.50-.60	.60- .90	.040	.050	.....				
	1060	C 1060	.55-.65	.60- .90	.040	.050	.....				
	1066	C 1066	.60-.71	.80-1.10	.040	.050	.....				
	1070	C 1070	.65-.75	.70-1.00	.040	.050	.....				
	1080	C 1080	.75-.88	.60- .90	.040	.050	.....				
	1085	C 1085	.80-.93	.70-1.00	.040	.050	.....				
	1095	C 1095	.90-1.05	.30- .50	.040	.050	.....				
Free Cutting Steels	1111	B 1111	.08-.13	.60- .90	.09-.13	.10-.15	.....				
	1112	B 1112	.08-.13	.60- .90	.09-.13	.16-.23	.....				
	1113	B 1113	.08-.13	.60- .90	.09-.13	.24-.33	.....				
	1115	C 1115	.13-.18	.70-1.00	.045	.10-.15	.....	.....	.....	.....	.....
	1117	C 1117	.14-.20	1.00-1.30	.045	.08-.13	.....	.....	.....	.....	.....
	1118	C 1118	.14-.20	1.30-1.60	.045	.08-.13	.....	.....	.....	.....	.....
	1132	C 1132	.27-.34	1.35-1.65	.045	.08-.13	.....	.....	.....	.....	.....
	1137	C 1137	.32-.39	1.35-1.65	.045	.08-.13	.....	.....	.....	.....	.....
	1141	C 1141	.37-.45	1.35-1.65	.045	.08-.13	.....	.....	.....	.....	.....
Manganese Steels	1330	NE 1330	.28-.33	1.60-1.90	...	...	.20-.35	.....	.....	.....	.....
	1335	NE 1335	.33-.38	1.60-1.90	...	...	.20-.35	.....	.....	.....	.....
	1340	NE 1340	.38-.43	1.60-1.90	...	...	.20-.35	.....	.....	.....	.....
		NE 1345	.43-.48	1.60-1.90	...	...	.20-.35	.....	.....	.....	.....
		NE 1350	.48-.53	1.60-1.90	...	...	.20-.35	.....	.....	.....	.....
Nickel Steels	2317	A 2317	.15-.20	.40- .60	.040	.040	.20-.35	3.25-3.75	.....	.....	NE 8620, 9420
	2330	A 2330	.28-.33	.60- .80	.040	.040	.20-.35	3.25-3.75	.....	.....	NE 1330, 8630, 9430
	2340	A 2340	.38-.43	.70- .90	.040	.040	.20-.35	3.25-3.75	.....	.....	NE 1345, 9442, 9542
	2345	A 2345	.43-.48	.70- .90	.040	.040	.20-.35	3.25-3.75	.....	.....	NE 1350, 9445
Nickel Chromium Steels	3115	A 3115	.13-.18	.40- .60	.040	.040	.20-.35	1.10-1.40	.55- .75	.....	NE 8620, 9420
	3120	A 3120	.17-.22	.60- .80	.040	.040	.20-.35	1.10-1.40	.55- .75	.....	NE 8620, 9420
	3130	A 3130	.28-.33	.60- .80	.040	.040	.20-.35	1.10-1.40	.55- .75	.....	NE 1330, 8630, 9430
	3135	A 3135	.33-.38	.60- .80	.040	.040	.20-.35	1.10-1.40	.55- .75	.....	NE 1335, 9435
	3140	A 3140	.38-.43	.70- .90	.040	.040	.20-.35	1.10-1.40	.55- .75	.....	NE 1345, 9440
	3141	A 3141	.38-.43	.70- .90	.040	.040	.20-.35	1.10-1.40	.70- .90	.....	NE 1345, 9442
	3145	A 3145	.43-.48	.70- .90	.040	.040	.20-.35	1.10-1.40	.70- .90	.....	NE 1350, 9445
	3150	A 3150	.48-.53	.70- .90	.040	.040	.20-.35	1.10-1.40	.70- .90	.....	NE 9450, 9550
	3240	A 3240	.38-.43	.40- .60	.040	.040	.20-.35	1.65-2.00	.90-1.20	.....	NE 1345, 9440
	3310	E 3310	.08-.13	.45- .60	.025	.025	.20-.35	3.25-3.75	1.40-1.75	.....	.....
Molybdenum Steels	4023	A 4023	.20-.25	.70- .90	.040	.040	.20-.35	.....	.....	.20-.30	NE 8620, 9420
	4027	A 4027	.25-.30	.70- .90	.040	.040	.20-.35	.....	.....	.20-.30	NE 9422
	4032	A 4032	.30-.35	.70- .90	.040	.040	.20-.35	.....	.....	.20-.30	NE 8620, 9422
	4037	A 4037	.35-.40	.75-1.00	.040	.040	.20-.35	.....	.....	.20-.30	NE 1330, 8630, 9430
	4042	A 4042	.40-.45	.75-1.00	.040	.040	.20-.35	.....	.....	.20-.30	NE 1330, 8630, 9430
	4047	A 4047	.45-.50	.75-1.00	.040	.040	.20-.35	.....	.....	.20-.30	NE 1335, 9435
	4063	A 4063	.60-.67	.75-1.00	.040	.040	.20-.35	.....	.....	.20-.30	NE 9255
	4068	A 4068	.64-.72	.75-1.00	.040	.040	.20-.35	.....	.....	.20-.30	NE 9262
	4119	A 4119	.17-.22	.70- .90	.040	.040	.20-.35	.....	.40- .60	.20-.30	NE 8613, 8615, 8617, 8620, 8720, 9420
	4125	A 4125	.23-.28	.70- .90	.040	.040	.20-.35	.....	.40- .60	.20-.30	.....

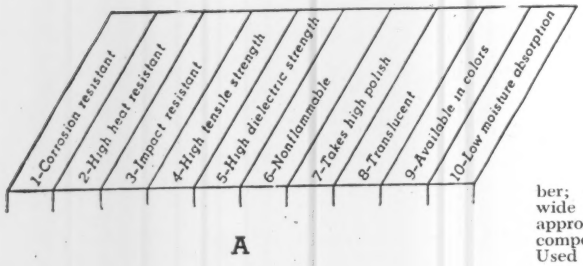
STANDARD steels here listed include all the current SAE steels and NE steels. Because of the necessity of conserving critical alloying materials, the plain carbon and low alloy steels must be used in preference to the higher alloy steels wherever possible. The NE steels listed in the final column as alternatives are those having approximately the same hardenability values and, in many cases, the same general characteristics.

	SAE No.	AISI or NE No.	Chemical Composition Limits, Per Cent C	Mn	P(max.)	S(max.)	Si	Ni	Cr	Mo	Low Alloy Alternatives
Molybdenum Steels (Cont'd.)*	4130	A 4130	.28-.33	.40- .60	.040	.040	.20-.35	.....	.80-1.10	.15-.25	NE 1330, 8630, 9430
	4137	A 4137	.35-.40	.70- .90	.040	.040	.20-.35	.....	.80-1.10	.15-.25	NE 1340, 9437
	4140	A 4140	.38-.43	.75-1.00	.040	.040	.20-.35	.....	.80-1.10	.15-.25	NE 1345, 9440
	4145	A 4145	.43-.48	.75-1.00	.040	.040	.20-.35	.....	.80-1.10	.15-.25	NE 1350, 9445
	4150	A 4150	.46-.53	.75-1.00	.040	.040	.20-.35	.....	.80-1.10	.15-.25	NE 9450
	4320	A 4320	.17-.22	.45- .65	.040	.040	.20-.35	1.65-2.00	.40- .60	.20-.30	NE 8720, 9422
	4340	A 4340	.38-.43	.60- .80	.040	.040	.20-.35	1.65-2.00	.70- .90	.20-.30	NE 9540
	4615	A 4615	.13-.18	.45- .65	.040	.040	.20-.35	1.65-2.00	.....	.20-.30	NE 8613, 8615, 8617, 9415, 9420
	4620	A 4620	.17-.22	.45- .65	.040	.040	.20-.35	1.65-2.00	.....	.20-.30	NE 8613, 8615, 8617, 8620, 9415, 9420
	4640	A 4640	.38-.43	.60- .80	.040	.040	.20-.35	1.65-2.00	.....	.20-.30	NE 1340, 9437
	4815	A 4815	.13-.18	.40- .60	.040	.040	.20-.35	3.25-3.75	.....	.20-.30	NE 8613, 8615, 8617, 8720, 9415, 9420
	4820	A 4820	.18-.23	.50- .70	.040	.040	.20-.35	3.25-3.75	.....	.20-.30	NE 8720, 8620, 9422
Chromium Steels	5120	A 5120	.17- .22	.70- .90	.040	.040	.20-.35	.....	.70- .90	.....	NE 8613, 8615, 8617, 8620, 8720, 9420
	5140	A 5140	.38- .43	.70- .90	.040	.040	.20-.35	.....	.70- .90	.....	NE 1340, 9435, 9537
	5150	A 5150	.48- .55	.70- .90	.040	.040	.20-.35	.....	.70- .90	.....	NE 1350, 9445, 9550
	52100	E 52100	.95-1.10	.25- .45	.025	.025	.20-.35	.....	1.20-1.50	.....	NE 52100A
	.....	NE 52100A	.95-1.10	.25- .45	...	...	.20-.35	.35 Max.	1.30-1.60	.08 Max.	.....
	.....	NE 52100B	.95-1.10	.25- .45	...	...	.20-.35	.35 Max.	.90-1.15	.08 Max.	.....
	.....	NE 52100C	.95-1.10	.25- .45	...	...	.20-.35	.35 Max.	.40- .60	.08 Max.	.....
Chromium Vanadium Steel	6150†	.....	.48-.55	.65- .90	.040	.040	.20-.35	.....	.80-1.10	.....	NE 1350, 9445, 9550
Nickel Chromium Molybdenum Steels	.....	NE 8613	.12-.17	.70- .90	...	...	.20-.35	.40- .70	.40- .60	.15-.25	NE 9415, 9420
	.....	NE 8615	.13-.18	.70- .90	...	...	.20-.35	.40- .70	.40- .60	.15-.25	NE 9415, 9420
	.....	NE 8617	.15-.20	.70- .90	...	...	.20-.35	.40- .70	.40- .60	.15-.25	NE 9415, 9420
	.....	NE 8620	.18-.23	.70- .90	...	...	.20-.35	.40- .70	.40- .60	.15-.25	NE 9415, 9420
	.....	NE 8630	.28-.33	.70- .90	...	...	.20-.35	.40- .70	.40- .60	.15-.25	NE 1330, 9430
	.....	NE 8720	.18-.23	.70- .90	...	...	.20-.35	.40- .70	.40- .60	.20-.30	NE 9422
Silicon Manganese Steels	.....	NE 9255	.50-.60	.70- .95	...	...	1.80-2.20	.....	.....	.....	.....
	9260	NE 9260	.55-.65	.75-1.00	...	...	1.80-2.20	.....	.....	.....	.....
	.....	NE 9262	.55-.65	.75-1.00	...	...	1.80-2.20	.....	.25- .40	.....	.....
Manganese Silicon Chromium Nickel Molybdenum Steels	.....	NE 9415	.13-.18	.80-1.10	...	...	.20-.35	.30- .60	.30- .50	.08-.15	NE 8613, 8615, 8617, 8620, 8720
	.....	NE 9420	.18-.23	.80-1.10	...	...	20.-35	.30- .60	.30- .50	.08-.15	NE 8613, 8615, 8617, 8620, 8720
	.....	NE 9422	.20-.25	.80-1.10	...	...	.20-.35	.30- .60	.30- .50	.08-.15	NE 8620
	.....	NE 9430	.28-.33	.90-1.20	...	...	.20-.35	.30- .60	.30- .50	.08-.15	NE 1330, 8630
	.....	NE 9435	.33-.38	.90-1.20	...	...	.20-.35	.30- .60	.30- .50	.08-.15	NE 1335
	.....	NE 9437	.35-.40	.90-1.20	...	...	.20-.35	.30- .60	.30- .50	.08-.15	NE 1340
	.....	NE 9440	.38-.43	.90-1.20	...	...	.20-.35	.30- .60	.30- .50	.08-.15	NE 1345
	.....	NE 9442	.40-.45	1.00-1.30	...	...	.20-.35	.30- .60	.30- .50	.08-.15	NE 1345
	.....	NE 9445	.43-.48	1.00-1.30	...	...	.20-.35	.30- .60	.30- .50	.08-.15	NE 1350
	.....	NE 9450	.48-.53	1.20-1.50	...	...	.20-.35	.30- .60	.30- .50	.08-.15	.....
	.....	NE 9537	.35-.40	1.20-1.50	...	...	.40-.60	.40- .70	.40- .60	.15-.25	NE 1340, 9435
	.....	NE 9540	.38-.43	1.20-1.50	...	...	.40-.60	.40- .70	.40- .60	.15-.25	NE 1345
	.....	NE 9542	.40-.45	1.20-1.50	...	...	.40-.60	.40- .70	.40- .60	.15-.25	NE 1345
	.....	NE 9550	.48-.53	1.20-1.50	...	...	.40-.60	.40- .70	.40- .60	.15-.25	NE 1350
Chromium Nickel Austenitic Steels°	30615—1	303	.15 Max.	2.00 Max.	.040	.18-.35	.75 Max.	7.00-10.00	17.00-20.00	.60 Max.	.....
	30615—2‡	303	.15 Max.	2.00 Max.	.12-.17	.040	.75 Max.	7.00-10.00	17.00-20.00	.60 Max.	.....
	30705§	347	.08 Max.	2.50 Max.	.030	.030	1.50 Max.	8.00 Min.	17.00 Min.	.....	.....
	30805	316	.10 Max.	2.50 Max.	.030	.030	.75 Max.	10.00-14.00	16.00-18.00	2.00-3.00	.....
	30905	304	.08 Max.	2.00 Max.	.030	.030	.75 Max.	8.00-10.00	18.00-20.00	.....	.....
	30915	302	.08-.15	2.00 Max.	.030	.030	.75 Max.	7.00-10.00	17.00-20.00	.....	.....
Stainless Chromium Irons°	51210	410	.08-.15	.60 Max.	.030	.030	.50 Max.	.....	11.5-13.0	.....	.....
	51310	414	.08-.15	.60 Max.	.030	.030	.50 Max.	1.25-2.00	11.5-13.5	.....	.....
	51335	420	.25-.40	.60 Max.	.030	.030	.50 Max.	.....	12.0-14.0	.....	.....
	51410X	416	.13 Max.	1.20 Max.	.040	.18-.35	.75 Max.	.....	12.0-14.0	.60 Max.	.....
	51710	430	.12 Max.	.60 Max.	.030	.030	.50 Max.	.....	16.0-18.0	.....	.....

°Subject to early revision. †Also contains Vanadium .15 per cent min. ‡Also contains selenium .15-.35 per cent. §Also contains Titanium .40 per cent min. or Columbium .70 per cent min. AISI denotes American iron and Steel Institute. Prefix A denotes an open-hearth alloy steel. Prefix B denotes an acid bessemer steel. Prefix C denotes an open-hearth carbon steel. Prefix E denotes an electric furnace steel. Prefix NE denotes a national emergency steel.

Plastics and Other Nonmetallics Listed by Tradenames

(For listing by producing companies, and complete street addresses, see Page 199)



A

1 - 3 - - - - - - - -

ACADIA—Acadia Synthetic Products, Division of Western Felt Works, Chicago. Synthetic rubber compounds to meet Army, Navy and AMS specifications in sheets, extrusions and molded parts.

See advertisement, Pages 237, 246

1 - - - - - 7 - - 10

ACE—American Hard Rubber Co., New York. Hard rubber; thermosetting; furnished in sheets, rods or tubes; may be machined, molded or stamped into part; corrosion-resistant; low moisture absorption; high polish; tensile strength, 4000-10,000 lb. per sq. in.; heat resistance, 140-240 degrees Fahr.; dielectric strength, 450-550 volts per mil.; nonflammable. Uses include handles, caster wheels and special molded parts.

1 - 3 - - - - - - - -

AEROLITE—Pittsburgh Plate Glass Co., Pittsburgh. Laminated thin, window glass with Vinal plastic binder, furnished in flat and bent sheets; corrosion and abrasion resistance, high; heat-resistant up to 160 degrees Fahr.; flexibility, low; moisture absorption, low; nonflammable; shatterproof; transparent; highly polished; for windows where low weight is important.

1 2 - - - 6 - - - -

AERTITE—Johns-Manville, New York. Rubbery, asphaltic-asbestos base; furnished in soft plastic form; corrosion-resistant, heat-resistant; nonflammable. Used on mechanical equipment to prevent air infiltration.

1 - - - - - - - - 10

AMBERLITE—Resinous Products & Chemical Co., Philadelphia 5. A synthetic resin (adhesive) phenolic resin; furnished in powder form; has low moisture absorption, high density; used in manufacture of waterproof plywood for aircraft and marine use.

- - 3 - - 6 - - 9 -

AMERICAN FELT—American Felt Co., Glenville, Conn. Felt material furnished in sheet, rods or tubes; for machining, stamping and extruding into parts. Abrasion resistance for certain felts is low, while for others high; resists corrosion caused by neutral conditions; heat-resistant to 250 degrees Fahr.; flexibility, low, medium or high (as specified); moisture absorption, also as specified; produced in any color; for oil retaining, dust excluding, filtering and vibration dampening.

See advertisement, Page 240

1 2 - 4 - - - - - - -

AMERICAN PLYWOOD—American Plywood Corp., New London, Wis. Phenolic urea plywood, furnished in sheet and laminated form; for machining into parts. Abrasion resistance, medium; heat-resistant to 300 degrees Fahr.; flexibility, high; tensile strength, ult., 12,000 lb. per sq. in.; moisture absorption, medium; inflammable; shatterproof; opaque; can be highly polished.

1 2 - - - - - - - - -

AMERIPOL—Miller Rubber Industrial Products Div. of The B. F. Goodrich Co., Akron, O. Oil-resisting and heat-resisting synthetic rubber; compounded and vulcanized to give wide range of properties. Tensile strength, approximately 4000 lb. per sq. in. In uncompounded form, has specific gravity of 1. Used for grease seals, packing rings, grommets and washers.

1 - 3 4 - - - - - - -

ANCHOR Extruded Plastics—Anchor Plastics Co., New York. Cellulose ester, thermoplastic; abrasion-resistant; heat-resistant up to 140-150 degrees Fahr.; flexible; dielectric strength at 60 cycles, 350-900 volts per mil; compressive strength, 2500-9900 lb. per sq. in.; moisture absorption, low; available in color; shatterproof; specific gravity, 114-137; translucent; opaque; machinability, good.

1 - - - - - - - - - -

ARMSTRONG—Armstrong Cork Co., Lancaster, Pa. Compositions of cork and Neoprene, Buna N, or Thiokol. More than two dozen materials having a wide range of physical properties; furnished in roll, sheet, cut gasket, molded, and extruded forms. Impervious to liquids and gases; highly resistant to deterioration by oils, solvents and most other liquids, gases, corona and weather; high and low coefficients of friction, high and low degrees of compressibility, lateral flow, etc.; available with fabric backing, with or without adhesive coating. Furnished to meet specific requirements. Used as gaskets, packings, washers, valve disks, feed rolls, polishing wheels, diaphragms, friction and vibration pads, etc.

Compositions of cork and natural rubber, for similar applications not requiring the special characteristics of synthetics.

Straight synthetic rubber compositions, for similar applications where lateral flow is necessary or not objectionable.

Straight cork compositions, ranging in density from 8 lb. to 36 lb. per cu. ft., in compressibility from 5 to 60 per cent, in tensile strength from 60 to 450 lb. per sq. in.

Fibrated leather and other fiber sheet packings for general gasketing including noncorrosive.

Rag felt papers for vibration damping, space packing, anti-squeak lining and use as gaskets, dust seals, etc.

See advertisement, Page 224

B

1 2 3 4 5 6 - 8 9 10

BAKELITE—Bakelite Corp., New York.

1 - - - - 6 - - - 10

Phenolic plastics, general purpose; thermosetting; furnished in granular form for plastic molding; corrosion-resistant, dielectric strength at 60 cycles, 270-350 volts per mil.; non-flammable; tensile strength, 6000-11,000 lb. per sq. in.; low thermal conductivity; available in dark colors; takes high polish; low moisture absorption.

1 2 - - - - - - - 10

Phenolic plastics, mineral filled. Similar to above. Has high heat resistance, low moisture absorption; and is nonflammable.

1 - 3 - 5 - - - - -

Phenolic plastics, fabric-filled. Similar to general purpose phenolic plastics but are much higher in impact resistance; abrasion-resistant; impact strength (Izod) .23-2.7 ft. lb. energy to break. Used for gears, bushings, bearings and heavy-duty parts.

1 - - - 5 - - 8 - -

Urea plastics. Thermosetting; furnished in powder form for plastic molding; specific gravity, 1.47-1.52; tensile strength, 9500-12,000 lb. per sq. in.; dielectric strength 330-375 volts per mil.; nonflammable; takes high polish; available in colors and translucent pastel shades. Used for housings and other parts requiring translucent or opaque colors resistant to fading.

- - 3 - - - - 8 9 10

Cellulose acetate plastics. Thermoplastic; furnished in powder form for plastic molding in transparent, translucent and opaque effects, in all colors; takes high polish; impact strength, (Izod) .7-2.0 ft. lb. energy to break; tensile strength, 2500-9500 lb. per sq. in.; suitable for wide variety of mechanical parts requiring brilliant color and high shock resistance.

1 - - - 5 6 - - - -

Polystyrene plastics. Thermoplastic; furnished in powder form for molding; transparent, translucent and opaque effects, in all colors; takes high polish; nonflammable; low moisture absorption; specific gravity 1.05-1.07; dielectric strength at 60 cycles 500-525 volts per mil.; volume resistivity 10^{9} megohm centimeters; power factor .0002-.0003 from 60 cycles to 50,000,000 cycles; offers exceptional resistance to acids and alkalis.

1 - - - 5 6 - - - -

Cast resins; produced as BT 44, 45, 48, 55 and 58 types; in rods, sheets, tubes and many special types of castings. BT 44, 45 and 55 are opaque, transiucent and mottled; corrosion resistant; of high dielectric strength; available in colors; and low moisture absorption; used for radio cabinets, etc. BT 48 and 58 are crystal clear, mottled transparents, and transparent colors of any hue; available as castings including rods, sheets and tubes; highly resistant to acids; used in place of glass and can be readily machined and used for gauges, peep holes, etc.

1 2 3 - - - - - - -

BT 63,000 resin is available in ivory, in rods and many other shapes; used for applications where dimensional stability is required; impact and heat resistant.

1 - 3 4 - - - - - -

BT 61-893; available in plates only; transparent water white; very stable; color-fast; excellent on dimensional stability; used for photoelastic stress study work.

1 - - 4 - - - - - 10

BT 41-001; available in transparent amber castings and sheets made to order; resistant to hydrofluoric acid; used where very high dielectric strength and low moisture absorption properties are required.

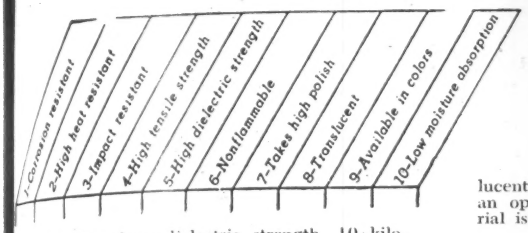
BT-48-306; nonstatic, used for instrument windows and comes within Navy Specifications.

1 - - - - 5 - - 8 - -

BEETLE—Plastics Division, American Cyanamid Co., New York. Urea-formaldehyde base, thermosetting; furnished in powder or granules for molding purposes; available in colors; translucent; high polish; dielectric strength 385 volts per mil.; tensile strength 5500-7000 lb. per sq. in. Used for housings, cabinets, knobs, dials and insulators.

1 - - - - 6 - 8 - -

BLUE RIDGE Rolled Figured and Wire Glass—Blue Ridge Div., Libbey-Owens-Ford Glass Co., Toledo, O. Glass furnished in sheet form for cutting and bending into parts; abrasion resistance, high; resists corrosion caused by everything except hydrofluoric acid; heat-resistant to 130-154 degrees Fahr.



flexibility, low; dielectric strength, 10 kilovolts per mil; tensile strength, 6500 lb. per sq. in.; compressive, 36,000 lb. per one-inch cube; moisture absorption, low; nonflammable; available in color; specific gravity, 2.5; in transparent and translucent types; used for covers and safety guards, utilizing polished wire glass, or tempered glass.

See advertisement, Page 225

- 2 - 4 - - - - - 9 -

BOOTH FELT—Booth Felt Co. Inc., Brooklyn, N. Y. Wool base felt; furnished in sheets or strips for machining or stamping into parts; heat resistance 400 degrees Fahr.; tensile strength, 5-100 lb. per sq. in.; available in colors and in a variety of types and grades; used for washers, gaskets, grease seals, and pads for insulating machinery or reducing vibration.

1 2 - - 5 - - - - - -

BUTYL—Stanco Distributors Inc., New York 4. Synthetic rubber, isobutylene-diolefin polymer, thermosetting material, furnished in sheets for molding or extruding into parts; abrasion resistance, medium; resists corrosion caused by acids and alkalis; heat-resistant to 300 degrees Fahr.; flexibility, high; dielectric constant, 2.1 at 1000 cycles; tensile strength, 3400 lb. per sq. in.; moisture absorption, low; specific gravity, .91; translucent; used for machine mountings, chemical equipment, electrical insulation, etc.

C

1 2 - - - - - - - - -

CARBOCELL—National Carbon Co. Inc., Carbon Products Div., Cleveland. Porous carbon available in a variety of standard and special elements, in open and blind end tubes, rods up to 36 inches in length and 6¾ inches in diameter, and plates with maximum dimensions of 12 x 12 x 1½ inches, and disks up to 12 inches in diameter; easily machined and fabricated into shapes; resistant to acids and alkalies; not subject to fracture and spalling from thermal shock; for use in filtration of corrosive liquids and gases and in conditions where thermal shock may be expected in chemical and process industries.

- - - 4 - 6 - - - 10

CATABOND—Catalin Corp., New York. Phenolic base. Liquid phenolic, thermosetting, laminating and bonding resin; nonflammable; low moisture absorption; fungi-resistant. Used for abrasive wheels, laminated products, surface coating, impregnating and bonding.

1 - - - 5 6 - - - -

CATALIN—Catalin Corp., New York. Phenolic base, thermosetting; furnished in sheets, rods or tubes, or special castings; high dielectric strength; nonflammable; low moisture absorption; high tensile and compressive strengths; high abrasion resistance; available in colors; insoluble in ordinary solvents. Used for clock and instrument cases, auto fittings, knobs for electrical appliances, etc.

1 2 - - - 6 - - - -

CELITE—Johns-Manville, New York, Diatomaceous silica material; furnished in powdered, granular and brick forms; resistant to chemical corrosion; heat-resistant; nonflammable. Used for insulation of equipment operating at high temperatures.

- - 3 - - - 7 - 9 -

CELANESE CELLULOID—Celanese Celluloid Corp., Plastics Div., New York. Cellulose-nitrate base, thermoplastic; furnished in sheets, rods and tubes; used for molding, swedging, veneering, machining or stamping into parts; available in colors; high polish; tensile strength 5000-10,000 lb. per sq. in.; flexible; resistant to corrosion; dielectric strength 600-1200 volts per mil; transparent. Used for instrument dials, tool handles, key buttons, register wheels, ammunition components, etc.

1 - 3 - - - - - 8 - -

CEL-O-GLASS—E. I. du Pont de Nemours & Co., Wilmington, Del. Plastic-coated wire mesh which transmits ultra-violet rays; corrosion-resistant; resistant to shock; translucent; flexible; light in weight. Used where an opalescent or translucent, flexible material is required.

1 - 3 4 - - - - - - -

CELORON—Continental-Diamond Fibre Co., Newark, Del. Resinous base, thermosetting; furnished in molded parts and laminated forms, for machining into parts; corrosion-resistant; resistant to shock; high tensile and dielectric strength; low moisture absorption; high heat resistance and abrasion resistance; takes high polish. Grade C (canvas base) used for heavy-duty gears. Type L (linen base) used for small gears of fine pitch and narrow face, and intricate punchings.

1 - - - 5 - - 8 - -

CENTRALINE—Central Paper Co. Inc., Muskegon 28, Mich. Wood-cellulose fiber, bleached or unbleached, or of specialty fiber; furnished either coated or saturated with plastic materials; in rolls or sheets, both plain and laminated of two or more thicknesses; abrasion-resistant; resists corrosion caused by atmospheric conditions; heat-resistant; flexible or stiff; low dielectric strength or as high as 325 volts per mil depending on final thickness of paper; tensile strength can be varied as can moisture absorption; available in color; translucent or opaque; used for coils, motors, gaskets, shims, noncorrosive separations, insulating, filtering, etc.

1 - - - - 8 - - - 10

CERAWARE—General Ceramics Co., New York. Ceramic material for molding, casting, machining and extruding; abrasion resistance, high; resists corrosion except by hydrofluoric acid and caustic alkalies; flexibility, low; heat-resistant to 250 degrees Fahr.; tensile strength, 2000 lb. per sq. in.; compressive, 80,000; moisture absorption, low; specific gravity, 2.2; opaque; machinability, fair; used for chemical equipment generally.

1 - 3 - 5 - - - - -

CHEMACO — Manufacturers Chemical Corp., Berkeley Heights, N. J. Cellulose base thermoplastic furnished in powder form for molding, machining and extruding; abrasion resistance, medium; resists corrosion caused by weak acids and alkalis; heat-resistant to 200 degrees Fahr.; flexibility, medium; dielectric strength, excellent; tensile strength, 4000-10,000 lb. per sq. in.; compressive, 11,000-27,000; moisture absorption, low; available in colors, from clear transparent to opaque; shatterproof; high impact resistance; for knobs, handles, dials and housings.

1 2 - - 5 - - - - -

CIBANITE—Ciba Products Corp., Hoboken, N. J. Aniline-formaldehyde resin, thermoplastic; furnished in powder form for molding and machining. Abrasion-resistant; resists corrosion caused by alkalies; heat-resistant up to 247 degrees Fahr.; flexibility, low; dielectric strength, 400-600 volts per mil; tensile strength, 8200 lb. per sq. in.; compressive, 24,000; moisture absorption, .01-.08 per cent; available in natural brown color; impact strength, .30 ft. lb. per in.; specific gravity, 1.22-1.25; translucent; machinability, good; for use where good strength with electrical properties are required, such as for stator insulation, tube bases, coil forms, terminal boards, strips and blocks.

1 2 - - - - - - - - 10

COLONIAL CERAMICS—The Colonial Insulator Co., Akron, O. Ceramic base material for molding, casting, stamping and extruding. Has high abrasion resistance; resists corrosion caused by most acids and alkalies; heat-resistant to 2000 degrees Fahr.; moisture absorption, low; available in colors, opaque; machinability, poor.

- - 3 4 - - - - - -

CO-RO-LITE—Columbian Rope Co., Auburn, N. Y. Phenolic base resin material, furnished in sheet form for molding into parts. Abrasion resistance, high; heat-resistant up to 350 degrees Fahr.; flexibility, medium; tensile strength, 11,000 lb. per sq. in.; flammable; can be highly polished; opaque; and can be produced in color. Used for cams, gears, bobbin heads, bearings, tension and compression members, etc.

1 - 2 - 5 - - - - -

CRYSTALITE—Rohm & Haas Co., Philadelphia 5. Acrylic base, thermoplastic; furnished in molding powder for compression and injection molding; corrosion-resistant; resistant to shock; transparent; flexible; specific gravity, 1.18; tensile strength, 4000-6000 lb. per sq. in.; available in colors and high polish. Used for unbreakable fuel gages, dials and dial covers and moldings of all kinds.

See advertisement, Page 125

D

- - 3 - - 6 7 - - -

DENSEWOOD—Densewood Corp., Elkhorn, Wis. A wood-base, thermoplastic material to be machined into parts. Abrasion resistance, medium; heat-resistant to 350 degrees Fahr.; flexibility, low; tensile strength, 18,000 lb. per sq. in.; compressive, 14,400 lb. per sq. in.; moisture absorption, low; nonflammable; specific gravity, 1.15; opaque; can be highly polished. Used for pulleys, rollers, pushbuttons, etc.

- - - 4 5 - - - 9 -

DIAMOND — Continental-Diamond Fibre Co., Newark, Del. Vulcanized fiber, bone-like material; furnished in sheets, rods and tubes, for machining, sawing or punching into parts; high tensile and dielectric strengths; low specific gravity; tough; pliable; impact-resistant; used for insulating members, bobbin heads, etc.

- - - - 5 - - - 9 -

DILECTENE—Continental Diamond Fibre Co., Newark, Del. Insulating material available in two grades:

No. 100; pure aniline-formaldehyde synthetic resin, which contains no celluiosic filling materials; highly resistant to moisture and electrically very stable; specific gravity, 1.21; tensile strength, 10,500 lb. per sq. in.; flexural strength, 20,000 lb. per sq. in.; compression strength, 20,000 lb. per sq. in., and dielectric strength, 640-650 volts per mil.

- - - 4 5 - - - - 10

DILECTO — Continental-Diamond Fibre Co., Newark, Del. Phenolic base, thermosetting; furnished in laminated sheets, rods and tubes, for machining or stamping into parts; dielectric strength 270-500 volts per mil; low moisture absorption; tensile strength, 10,000-25,000 lb. per sq. in.; corrosion-resistant; heat resistance, 290 degrees Fahr.; available in colors; resistant to shock; takes high polish; impact-resistant; insoluble. Used for electrical, thermal and mechanical insulating parts.

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DUFELT—Felters Co. Inc., Boston. Laminated felt and Neoprene. Various thicknesses and lamination arrangements. Corrosion-resistant. Used for washers and strips for oil and grease retention where conditions are too exacting for use of plain felt. Petroleum-resistant.

See advertisement, Page 222

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DUOLITE—Pittsburgh Plate Glass Co., Pittsburgh. Laminated window glass with Vinal plastic binder; furnished in flat and bent sheets; corrosion and abrasion resistance, high; heat-resistant to 180 degrees Fahr.; flexibility, low; moisture absorption, low; nonflammable; shatterproof; transparent; highly polished; for windows which need not be optically perfect.

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DUPLATE—Pittsburgh Plate Glass Co., Pittsburgh. Laminated plate glass and Vinal plastic binder, furnished in flat and bent sheets; corrosion and abrasion resistance, high; heat-resistant to 180 degrees Fahr.; flexibility, low; moisture absorption, low; nonflammable; shatter-resistant; transparent; highly polished; for shatter-resistant windows, including those of high optical quality.

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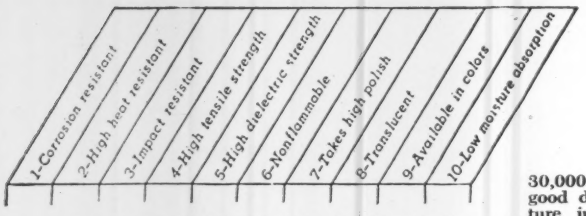
DUREZ—Durez Plastics & Chemicals Inc., North Tonawanda, N. Y.

Molding powders; phenolic base, thermosetting; for molding into parts; corrosion-resistant; highly polished; low moisture absorption; heat resistance, 350-550 degrees Fahr.; tensile strength, 4000-7000 lb. per sq. in.; available in colors; shock and abrasion-resistant. Used for housings, handles, bases, knobs, electrical parts, small gears, frames, hoods, etc.

Liquid resin (No. 7421); cast at low temperatures; compressive strength, 15,000-20,000 lb. per sq. in.; impact strength (energy to break ½ x ½-inch bar) .11-.15



ft. lb. Izod; flexural strength, 7000-9000 lb. per sq. in.; thermosetting; can be set by baking at temperatures above 100 degrees Cent.

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DURITE—Durite Plastics Inc., Frankford Sta., P. O., Philadelphia. Phenol-furfural and phenol-formaldehyde synthetic resins, heat-setting; available in crushed, pulverized or liquid form, for bonding hot or cold-molding compound, plywood, veneer, cements, abrasive articles, etc.; or in powder form for hot press-molding; possesses high heat and shock resistance; high tensile and dielectric strengths; corrosion resistance; nonflammability and low moisture absorption. Used for cabinets, housings, handles, keys, knobs, automotive ignition, hand wheels, terminals, tank periscopes, ordnance range finders, etc.

E

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EBROK—The Richardson Co., Melrose Park, Ill. Acid-resisting bituminous plastic for specific requirements including such parts as battery containers.

See advertisement, Page 126

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EEL-SLIP—Johns-Manville, New York. Asbestos fiber, graphite and rubber compound; heat-resistant; high tensile strength; nonflammable. Used for bearings, suction box covers, etc.

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ETHOCEL—The Dow Chemical Co., Midland, Mich. Plastic granules, thermoplastic; furnished in granular form for injection and extrusion molding; dielectric strength, 1500 volts per mil on .01-in. thickness; tensile strength, 7000-8500 lb. per sq. in.; compressive strength, 10-12,000 lb. per sq. in.; heat resistance, 130-150 degrees Fahr.; high impact strength at low temperature; low moisture absorption; good dimensional stability; available in color; specific gravity, 1.10-1.25; translucent; opaque. Used where dimensional stability is required. Also furnished in sheeting.

See advertisement, Page 155

F

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FS—Irvington Varnish & Insulator Co., Irvington, N. J. Radio spaghetti; a braided cotton sleeving coated with a smooth, continuous, lacquer film; conforms to A.S.T.M. specifications for Grade B-2 flexible varnished tubing; highly resistant to aging; obtainable in five colors.

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FV—Irvington Varnish & Insulator Co., Irvington, N. J. Flexible lacquered tubing for electrical insulation; meets A.S.T.M. standards for grade A-2 flexible varnished tubing; resistant to aging, oil, moisture, acid vapors, weak alkalies. Obtainable in five colors.

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FARLITE—Farley & Loetscher Mfg. Co., Dubuque, Ia. A series of nonmetallic materials, furnished in the following types:

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Phenolic and urea base, thermosetting materials, produced under the name "Farlite"; furnished in laminated sheets to 36 x 84; for machining and stamping into parts; corrosion-resistant; highly polished; low moisture absorption; impact-resistant; available in colors; tensile strength, 6000-8000 lb. per sq. in.; dielectric strength, to 700 volts per mil. Used for sawed or stamped flat parts for light machine members.

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Compreg; wood veneer ($\frac{1}{16}$ or $\frac{1}{8}$-in.) impregnated with thermosetting synthetic resins before compressing. Thickness to 2 in.; for machining with same tools as for cast iron. Material is impact and corrosion-resistant; has low moisture absorption; tensile strength, 30,000 lb. per sq. in.; compressive, 20,000; good dimensional stability; modulus of rupture in bending, 35,000 lb. per sq. in.; used for bearing plates, bolts, studs, propeller blades, instrument panels, mechanical spacers, etc.

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Gear stock; fabric base, impregnated with thermosetting resins. Furnished in blanks of desired thickness; high moisture resistance; tensile strength, to 11,000 lb. per sq. in.; compressive, 39,500; flexural, to 20,000; and dielectric strength, to 700 volts per mil.

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Safety tread; abrasive surface material bonded with phenol-formaldehyde resin under heat and pressure to metal, resinous sheet stock or wood. Abrasive material hardest known except diamond. Very coarse to fine. Waterproof, oil and greaseproof; nonslip; acid-resistant. No distortion less than 300 degrees Fahr.; furnished in sheets or fabricated form to specifications; molded to simple shapes; used on buses, trains, ships, airplanes, stairways; catwalks and machine platforms.

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FEATHERWEIGHT—Keasbey & Mattison Co., Ambler, Pa. Magnesia blocks, pipe covering and cement. Combination of magnesia and asbestos in powder or molded form with exceptionally low thermal conductivity. Used as a thermal insulating material where temperature does not exceed 600 degrees Fahr.

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FEL-PRO THIOKOL—Felt Products Co., Chicago. Thiokol strip material with specially processed felt base, producing spongy rubber which is weather-resistant. Available in lengths over 6 feet; used for vehicles for tailgate moldings, and for numerous industrial applications. Substitute for critical materials formerly utilized in gaskets and strips.

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FELTERS FELT—Felters Co. Inc., Boston. Nonwoven felts to S.A.E. and other specifications. Available either in the piece or cut to customer's requirements. Used for pads, bumpers, antisqueak and rattle parts, filters, polishing roll covering, shaft and bearing seals, etc. Petroleum-resistant.

See advertisement, Page 222

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FIBERGLAS—Owens-Corning Fiberglas Corp., Toledo, O.

Wool and textile: Three kinds of wool-type fibers: (1) for thermal and accoustical insulation, compressed to various densities, in form of bats, blankets, blocks, etc.; (2) for thin porous bonded mats; (3) for filter or aeration packs (coarse fibers). Two types of textile fibers—continuous filament and staple fiber—for service fabrics, chemical filtration, electrical insulation, reinforcement in laminates, plastics, etc. Basic properties: light weight, low thermal conductivity, good sound absorption, resistant to moisture, individual fibers are incombustible, durable, sanitary, wide temperature range (from sub-zero to 1000 degrees Fahr.).

Electrical insulations for magnet wire, motors, generators, transformers—varnished cloths used for high temperature cambric applications; inorganic backing and reinforcement in mica combinations; for producing electrical laminates; for high temperature electrical adhesive tape. Tapes used for binding coils and other parts to be impregnated after wrapping; various electrical applications. Electrical tying cord for binding coils in generators and armatures, in transformers and similar static applications. Braided sleevings are used for lead wires in motors and transformers and similar applications.

Dust-stop air-filters; used wherever air is moved mechanically in ventilating, heating and air-conditioning systems and in forced warm air furnaces.

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FIBESTOS—Monsanto Chemical Co., Plastics Div., Springfield, Mass. Cellulose-acetate; thermoplastic; furnished in sheet, laminated and powder forms or rods and tubes, for molding, machining, stamping or swaging into parts; resistant to corrosion; transparent; available in colors; flexible; tough; high polish; dielectric strength, 540-1800 volts per mil; tensile strength, 6000-6800 lb. per sq. in. Used for safety glass, and compressible shims, couplings, gaskets, electrically insulated knobs and handles, light diffusing panels, and molded shapes of all descriptions.

See advertisement, Page 227

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FIRECRETE—Johns-Manville, New York. A castable refractory (ceramic); furnished in powder for casting into parts; abrasion resistance, good; heat resistance, 2400 and 2800 degrees Fahr.; specific gravity, 110 lb. per cu. ft.; used for special shapes, door linings and other types of monolithic construction. Material can be quickly cast into any shape.

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FLEXSEAL—Pittsburgh Plate Glass Co., Pittsburgh. Laminated plate glass with extended Vinal plastic edge, furnished in flat and bent sheets; corrosion and abrasion resistance, high; heat-resistant to 180 degrees Fahr.; flexibility, medium; moisture absorption, low; shatterproof; transparent; highly polished; flexible edge simplifies installation; for windows having nonrigid frames or windows requiring an airtight edge seal.

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FORMICA—Formica Insulation Co., Cincinnati. Resinous base, thermosetting; furnished in laminated form, for machining or stamping into parts; corrosion-resistant; tensile strength is slightly less than cast iron; high dielectric strength; absorbs no oil; changes in dimensions only slightly as the result of moisture absorption. Used for insulating washers and bushings, punched parts in switches, automotive starting systems and all types of heavy-duty gears.

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Grade C; phenolic laminated fabric; thermosetting; furnished in laminated form and in rods or tubes; can be highly polished; corrosion-resistant to acids and salts, not alkalies; flexible in thin sections; dielectric strength, 200 volts per mil in $\frac{1}{8}$-inch thick; tensile strength, 10,000 lb. per sq. in.; heat resistance, 300 degrees Fahr.; used for silent gears.

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Grade MF; aniline-formaldehyde-glass thermosetting material; furnished in rods, tubes and laminated sheets, for molding, machining or stamping into parts; corrosion-resistant; heat-resistant to 280 degrees Fahr.; flexibility, medium; tensile strength, 14,000 lb. per sq. in.; compressive, 20,000 lb. per sq. in.; dielectric strength, 450 volts per mil; moisture absorption, low; nonflammable; shatterproof; opaque; for low-power loss insulation, to replace glass and porcelain parts in antenna mast bases, molded insulators, spacers, washers, etc.

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Grade XX; phenolic laminated paper; thermosetting; furnished in laminated form and in rods or tubes; can be highly polished; dielectric strength, 500 volts per mil; tensile strength, 12,000 lb. per sq. in.; heat resistance, 300 degrees Fahr.; available in natural and black; low moisture absorption; used for insulation for electrical equipment.

See advertisement, Page 135

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FYBEROID — Wilmington Fibre Specialty Co., Wilmington, Del. Paper base; furnished in sheet form, for machining or stamping into parts; dielectric strength, 200-400 volts per mil; tensile strength, 5000-8000 lb. per sq. in.; flexible; abrasion and corrosion-resistant. Used for insulation on motors, generators, automotive ignition starters, etc.

G

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GARIT—Garfield Mfg. Co., Garfield, N. J. Thermosetting, cold-molded plastic; corrosion-resistant; dielectric strength, 50-60 volts per mil; tensile strength, 1200 lb. per sq. in.; heat resistance, 500 degrees Fahr., moisture absorption, 2 per cent; nonflammable; compressive strength, 7500 lb. per sq. in.; used for molded insulation for electrical equipment.

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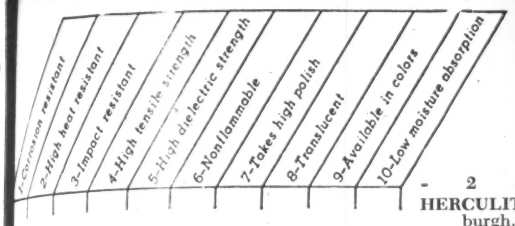
GASKOFELT — Western Felt Works, Chicago. Compact combination of felt with an oil-resistant rubber compound of great density and high tensile strength. Used for gasketing in connection with oil, steam, hot or cold water; temperatures up to 250 degrees Fahr.; pressures up to 225 lb.

See advertisements, Pages 237-246



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GEMFLEX—Gemloid Corp., Elmhurst, L. I., N. Y. Vinylite tubing and gasketing; thermoplastic material furnished in rods or tubes, for molding into parts; odorless, nontoxic and very slow-burning; exceptional resistance to oil moisture and most chemicals; strong and tough at lower than freezing temperatures; strong resistance to abrasion; high fatigue strength; unusual flexibility; for insulating, gasketing, etc.

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GEMLITE—Gemloid Corp., Elmhurst, L. I., N. Y. Acrylic butyrate, thermoplastic; furnished in laminated sheet, rods or tubes, for molding and extruding; corrosion and impact-resistant; high tensile and dielectric strengths; nonflammable; takes high polish; translucent; available in colors; moisture absorption, low; used for handles, knobs, controls, etc.

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GEMLOID—Gemloid Corp., Elmhurst, L. I., N. Y. Thermoplastic material, furnished in sheet and laminated form for stamping into parts; abrasion resistance, medium; heat resistance for thermoplastics is 175 degrees Fahr. and for thermosetting type, 400 degrees Fahr.; tensile strength, 4000-6000 lb. per sq. in.; moisture absorption, low; nonflammable; used for replacing metal nameplates.

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GRAPHICELL—National Carbon Co. Inc., Carbon Products Div., Cleveland. Porous graphite, available in plates, tubes and rods; uniform high porosity and small pore size; easily machined and fabricated into shapes; resistant to acids and alkalies; not subject to fracture and spalling frrom thermal shock; resistant to oxidation; high electrical conductivity; for filtration and gas dispersion.

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GRAPHITAR—United States Graphite Co., Saginaw, Mich. Carbon-graphite material used for bearings, thrust washers, seals, rotor vanes, etc., made in several grades of which the following is typical: compressive strength, 22,000 lb. per sq. in.; apparent density (grams per cu. cm.), 1.77; transverse breaking strength, 10,500 lb. per sq. in.; scleroscope hardness, 85; coefficient of thermal expansion 75-620 degrees Fahr. (in. per in. per degree Fahr.), .0000017.

See advertisement, Page 156

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GUMMON—Garfield Mfg. Co., Garfield N. J. Black, cold-molded; corrosion and heat-resistant (450 degrees Fahr.); high dielectric strength; high polish; resistant to hot oil. Will not shrink, crack, warp or deteriorate with age; takes high polish; nonflammable. Used for insulated parts, etc.

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HARVEL Insulating Varnishes—Irvington Varnish & Insulator Co., Irvington, N. J. Special phenol-formaldehyde, polymerization type varnishes with exceptional penetrating power, excellent electrical properties; noncorrosive; unusual resistance to acids, dilute alkalies, moisture, lubricating and transformer oil; saves baking time required; hardening by polymerization rather than oxidation curing to infusable nonthermoplastic state; for use with any type of insulation. Also oleo-resinous types in clear and black, air-drying, baking.

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HASKELITE—Haskelite Mfg. Corp., Grand Rapids 2, Mich. Resin-bonded plywood; light weight; high strength; elastic; hard; bendable into desired forms and shapes. Used for airplanes, buses, street cars, railways, radio cabinets and speakers, passenger cars, landing, PT and assault boats, etc.

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HEMIT — Garfield Mfg. Co., Garfield, N. J. Cold-molded, gray-white refractory material; corrosion-resistant; heat resistance 1500-1750 degrees Fahr.; low moisture absorption when impregnated; high dielectric strength; nonflammable. Used for interior parts of heating devices, or where a molded part must withstand an arc.

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HERCULITE—Pittsburgh Plate Glass Co., Pittsburgh. Tempered or heat-treated plate glass, furnished in flat and bent sheets; corrosion and abrasion resistance, high; heat-resistant to 650 degrees Fahr.; flexibility, medium; tensile strength, 29,500 lb. per sq. in.; moisture absorption, low; nonflammable; specific gravity, 2.52; transparent; highly polished; for use as windows or any glass application requiring unusual strength.

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HYCAR—The Hycar Chemical Co., Akron, O. Vulcanizable types of synthetic rubbers of butadiene base furnished in crude sheet form to be compounded into any type of stock desired for further processing by molding, extruding, calendering, etc.

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Type OR-15 (oil-resistant); vulcanizable synthetic rubber, butadiene-acrylonitrile copolymer; furnished in sheet form; for molding, extruding and calendering; excellent oil, heat, abrasion and aging resistance; excellent flex life; tensile strength, 2500-4500 lb. per sq. in.; dielectric strength, 500 volts per mil; moisture absorption, medium; may be compounded in colors; used for all resilient parts.

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Type OR-25 (oil-resistant); vulcanizable synthetic rubber, butadiene-acrylonitrile copolymer; furnished in sheet form; for molding, extruding and calendering; abrasion resistance, high; resists corrosion caused by petroleum products; heat-resistant to 300 degrees Fahr.; flexibility, high; dielectric strength, 500 volts per mil; tensile strength 2000-3500 lb. per sq. in.; moisture absorption, low; may be compounded in colors.

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Type OS-10 (oil-soluble); vulcanizable synthetic rubber, butadiene-styrene copolymer; furnished in sheets; for molding, extruding and calendering; flexibility, high; tensile strength, 2000-3000 lb. per sq. in.; moisture absorption, low; takes color; for abrasive wheels, electrical insulation, and general replacement for natural rubber.

All types used for gaskets, tubing, vibration insulators, packings, hose, printing rollers and blankets, wire covering and jacketing, and any other general type of application where resilient materials are required. All can be compounded to bonehard (Ebonars) with a 100 degree Fahr. higher softening point than obtainable with natural hard rubber. All types also available in latex state for spreading, dipping and coating.

See advertisement, Page 119

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HYFLEX—Irvington Varnish & Insulator Co., Irvington, N. J. Flexible, rubber-like extruded plastic tubing; has excellent abrasion resistance; does not become brittle at temperatures as low as —50 degrees Fahr.; obtainable in six opaque colors; dielectric strength, 850 volts per mil (dry), 815 volts per mil (wet), with tubing of wall thickness approximately .02-inch; tensile strength, 3000 lb. per sq. in.; good chemical stability.

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HY-TEMP—Keasbey & Mattison Co., Ambler, Pa. Diatomaceous earth and asbestos base; combination heat-insulating blocks, cements and pipe covering; furnished in powder or molded form; high heat resistance; low moisture absorption; nonflammable; and low thermal conductivity. Used for thermal insulation up to 1900 degrees Fahr.

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ILLINOIS Chemical Porcelain—Illinois Electric Porcelain Co., Macomb, Ill. Furnished in rods or tubes; for molding, casting, machining and extruding; resists corrosion caused by all chemicals except hydrofluoric acid; heat-resistant to 250 degrees Fahr.; flexibility, low; tensile strength, 6000-8000 lb. per sq. in.; compressive, 100,000; specific gravity, 2.4-2.5; opaque; machinability, good; for chemical piping.

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INCELOID — American Products Mfg. Co., (Inceloid Co. Inc., subsidiary) New Orleans. Cellulose derivative, thermoplastic; furnished in sheet and laminated form for casting into parts; corrosion and heat-resistant; can be highly polished; flexible; high dielectric strength; low moisture absorption, available in colors; transparent; shatterproof. Used for electrical insulation, laminating work, cover shields, etc.

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INDUR—Reilly Tar & Chemical Corp., Indianapolis. Phenolic base, thermosetting; furnished in powder form, for molding into parts; tensile strength, 8560 lb. per sq. in.; high dielectric strength; nonflammable; low moisture absorption; high heat resistance; corrosion and abrasion-resistant; available in colors; flexibility, medium; specific gravity 1.37±. Used for instruments and machine accessories including insulating panels, knobs and handles, control levers, gears, etc.

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INDUR VARNISH—Reilly Tar & Chemical Corp., Indianapolis. Phenolic base, thermosetting; for molding into parts; high dielectric and tensile strengths; nonflammable; transparent; corrosion and high heat-resistant impact-resistant; and low moisture absorption. Used for laminated gears.

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INSULKOTE — Johns-Manville, New York. Weatherproof coating for use over insulation of ducts and other exposed equipment; corrosion and heat resistant; low moisture absorption.

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INSUROK—The Richardson Co., Melrose Park, Ill.

Thermosetting type; furnished in laminated sheets, rods and tubes for machining into parts, or as finished molded parts; corrosion-resistant; low moisture absorption; high tensile strength; resistant to shock; comparatively low specific gravity. Used for gears, bearings, electrical insulation. Available in different grades.

Thermoplastic type; furnished in molded parts; high dielectric strength; low moisture absorption; high tensile strength; low specific gravity. Available in color.

Translucent type; urea or phenolic base, thermosetting; in laminated sheets and fabricated parts, for instrument dials, etc. Material is translucent, does not support combustion, and has low moisture absorption.

See advertisement, Page 126

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IRVINGTON—Irvington Varnish & Insulator Co., Irvington, N. J. Varnished fabrics; varnished cambric, canvas, cotton, duck, Fiberglas, Nylon, rayon and SIC, thin cotton (alternate for silk). Controlled varnish formulations and selection of base materials. Varnished papers; ranging from thin condenser tissues to heavy fibrous types.

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Insulating varnishes; synthetic, internal-drying, clear insulating, oleo-resinous type varnishes; clear or black, baking, air drying; black air-drying; flashing or baking core-plate; clear or black oilproof finishing varnishes. Wide selection to meet ordinary and special requirements.

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Lead tubing; transformer lead tubing made to specifications, consisting of several layers of varnished cambric over which saturated braid had been drawn; assembly is dipped in varnish and thoroughly baked.

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Plastic marker insulators; extruded plastic tubing sleeves, marked to specifications; serve both as wire markers and lug insulators; high dielectric strength; resistant to heat, acids, alkalies, oil and many solvents; do not support combustion. Obtainable in numerous color combinations, in standard tubing sizes.

Varnished markers; short lengths of varnished tubing marked to specifications; used to identify leads; inside-and-out coatings resist oil, gasoline, washing down of motors, high engine temperatures.

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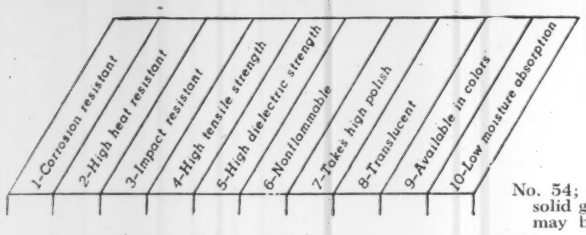
IRV-O-LITE—Irvington Varnish & Insulator Co., Irvington, N. J. Flexible extruded plastic tubing; high dielectric and tensile strength; resistance to tearing, abrasion, acids, alkalies, gasoline and other petroleum solvents, and most coal-tar solvents; does not support combustion; low moisture absorption; smooth inside and outside walls; chiefly used for wiring and lug insulation or as conduit; superior to rubber or metal tubing for specific applications. Two types, both available in six opaque colors: Type XTE-30 for general all-around usage, and XTE-130 for applica-



tions involving higher temperatures, greater dielectric and tensile strengths.

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IRV-O-SLOT—Irvington Varnish & Insulator Co., Irvington, N. J. Stator or armature slot insulation; thinnest types are resin-coated papers, others consist of varnished fabric duplexed to fish or 100 per cent rag papers; flexible binding adhesive prevents separation during shaping and forming, contributes to insulating qualities. Obtainable in a wide variety of combinations and thicknesses in the form of sheets, tape and punchings.

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IRV-O-VOLT—Irvington Varnish & Insulator Co., Irvington, N. J. Flexible varnished inside-and-out tubing. Braided cotton sleeving, treated with oleo-resinous varnishes.

Types A-1, B-1 and C; conform to ASTM specifications for similarly designated grades; inside varnish coating yields a smoother inside wall, speeding assemblies; greatly retards moisture absorption; eliminates feathering action of ordinary braid and wicking action when used in oil-filled transformers; provides margin of insulation protection should outside coating become chafed.

Type CT; special heavy walled saturated sleeving. All obtainable in six colors.

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IVI-FLEX—Irvington Varnish & Insulator Co., Irvington, N. J. Flexible extruded plastic tubing, developed for use at extremely low temperatures; withstands a hammer blow at —70 degrees Fahr.; can be pinched at —80 degrees Fahr.; dielectric strength, 600 volts per mil, wet or dry; tensile strength, 1000 lb. per sq. in.; elongation at break, 400 per cent.

K

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"K" FELT—American Felt Co., Glenville, Conn. Kapok felts to Air Corps Specification 16098, Types I and II. Material is corrosion-resistant impact-resistant and nonflammable; for insulating, etc.

See advertisement, Page 240

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KGI—Kopp Glass Inc., Swissvale, Pa. Glass for marine, aviation, railroad and industrial applications. Types include technical glass, ultra-violet glass, heat-resisting glass, colored glass, crystal clear and opal glass.

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KARBATE—National Carbon Co. Inc., Carbon Products Div., Cleveland. Carbon and graphite base, corrosion-resistant materials impervious to seepage of liquids and gases under pressure.

No. 10 Series (10, 11, 18 etc.); carbon base materials.

No. 20 Series (20, 21, 28 etc.); graphite base materials.

Available in the form of brick, plates, tile, pipe, fittings, valves, tower sections and tower accessories such as bubble caps, trays, distributor plates, etc.; highly resistant to reaction with most materials encountered in chemical manufacturing plants and chemical processes at the concentrations and temperatures ordinarily employed; resist action of all acids, alkalies and salt solutions except those of a highly oxidizing nature. No. 10 series have a lower thermal conductivity than the No. 20, while the latter are more resistant to oxidation.

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KEM-POL—The Sherwin Williams Co., Cleveland. Vulcanizable polymer derived from vegetable oils, thermoplastic; furnished in sheets and liquid; for molding, extruding and calendering; tensile strength, 300-500 lb. per sq. in.; takes color; hardness 40-65. Available in four different grades.

No. 14; viscous liquid, amber in color; easily soluble in aliphatic and aromatic hydrocarbons; may be emulsified.

No. 54; of intermediate viscosity; tacky, semi-solid gel-like material; soluble same as above; may be cured, milled and molded.

No. 11; most viscous of the untreated polymers; tacky solid, and darker in color than two above, being ruby red; soluble with difficulty if at all; can be emulsified.

No. 11-41 MP; based on No. 11 and represents this polymer in a precured state; dry, cream to tan colored sheet, with only slight tack; may be worked directly on rubber mill, without pretreatment.

Used for hose, rolls, braided tubing, pads, gaskets, insulation, fabric coatings, tapes, beltings, etc.

See advertisement, Pages 138, 139

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KOROSEAL—B. F. Goodrich Co., Akron, O. Synthetic elastic; furnished in various consistencies from jelly to bone-like hardness; corrosion and shock resistant; nonflammable; available in colors. Jelly is used for making molds for plastic casts, but other compounds sold only as finished products. Superior to rubber in flexing, oxidation and penetration of moisture or gases; does not swell in oil. Available in molded and extruded forms; also applied as coating to paper and fabric.

See advertisement, Page 228

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KYS-ITE K-100—Keyes Fibre Co., Waterville, Me. Phenolic fiber base, thermosetting material; for molding into parts; abrasion resistance medium; resists corrosion caused by water, mild acid and alkali; flexibility, low; dielectric strength, 300-400 volts per mil; tensile strength, 10,000-12,000 lb. per sq. in.; compressive, 35,000; moisture absorption, medium; produced in medium and dark shades; shatterproof; specific gravity, 1.39-1.45; opaque; machinability, good; for handwheels, small structural parts, etc.

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LAMICOID—Mica Insulator Co., New York. Phenolic and urea base thermosetting laminated sheets, rods and tubes, for machining and stamping into parts; can be furnished highly polished or satin; used for gears, electrical and mechanical insulation, instruction charts, dials, etc.

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LENOXITE—Lenoxite Div., Lenox Inc., Trenton, N. J. Steatite, ceramic high-frequency insulating material, for molding, casting, machining and extruding; abrasion resistance, high; resists corrosion caused by all except hydrofluoric acids; heat-resistant up to 1600 degrees Fahr.; flexibility, low; dielectric strength, over 275 ASTM D116-42; tensile strength, 10,000 lb. per sq. in.; compressive, 75,000; moisture absorption, low; available in white and very light cream; semi-shatterproof; specific gravity, 265; opaque; machinability, fair; for high-frequency radio insulators.

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LIGNOLITE—Marathon Chemical Co., Division of Marathon Paper Mills Co., Rothschild, Wis. Lignin plastic, furnished in laminated sheet form; for machining and stamping into parts; abrasion resistance, high; resists corrosion caused by acids, water and oil; heat-resistant up to 176 degrees Fahr.; flexibility, low; dielectric strength, 500-900 volts per mil; tensile strength, 7500-12,000 lb. per sq. in.; compressive, 25,000-35,000; moisture absorption, low; available in black only; specific gravity, 1.4; opaque; used in the electrical field as switchboards, switch-bases, barriers, terminal strips, insulating spacers, washers, nameplates, conveyor guides, cabinets, etc.

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LOALIN—Catalin Corp., New York. Polystyrene thermoplastic injection molding compound; excellent electrical properties; zero water absorption; specific gravity, 1.06; crystal clear. Used for insulating.

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LOF—Libbey-Owens-Ford Glass Co., Toledo, O.

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Heat-absorbing plate glass; furnished in sheet form; abrasion resistance, high; corrosion-resistant; heat absorbing; flexibility, medium; dielectric strength, .204 kilovolts per mil; tensile strength, 6000-36,000 lb. per sq. in.; compressive, 3000-10,000; moisture absorption, low; nonflammable; specific gravity, 2.52; transparent; highly polished; for use where light transmission or vision is desired with heat insulation.

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Polished plate glass; furnished in flat, bent and laminated form; in clear and colors; specific gravity, 2.5; highly polished; high dielectric strength; used for viewing windows.

See advertisement, Page 225

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LORD—Lord Mfg. Co., Erie, Pa. Rubber-bonded-to-metal, for a variety of uses including shear-type mountings for vibration isolation. Typical applications include aircraft, automotive, and marine engines; motors, pumps, compressors, general machinery, radio equipment, instruments etc., where vibration is encountered.

See advertisement, Page 141

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LUCITE—E. I. du Pont de Nemours & Co. Inc., Wilmington, Del. Methyl-methacrylate base, thermoplastic; furnished in powder or sheets, rods and tubes, for molding and machining into parts; transparent, translucent; high dielectric strength; available in colors; resistant to shock; low moisture absorption; high polish: resistant to corrosion; tensile strength, 5800-8000 lb. per sq. in.; heat resistance, 150-203 degrees Fahr. Used for panels, knobs, models, safety guards, dials and gage glasses, airplane enclosures and automatic parts.

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LUMARITH—Celanese Celluloid Corp., Plastics Div., New York. Two types of cellulose acetate base, thermoplastics.

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One grade furnished in sheets, powder or rods and tubes; powders for compression, injection and extrusion molding. Available in colors; tensile strength, 3000-15,000 lb. per sq. in.; dielectric strength 300-2000 volts per mil; high polish; flexible; resistant to shock and corrosion. Used as interior electrical parts, instruments, aircraft lever knobs, electrical insulation, steering wheels for aircraft and auto trucks, automotive door and window handles, gas mask lens, etc.

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Another is furnished in sheet and rolls or reels in thicknesses of .0007-.020, for laminating, swedging, drawing or stamping into parts; abrasion and corrosion-resistant; flexible; dielectric strength, 700-2500 volts per mil; tensile strength, 4500-11,000 lb. per sq. in.; heat-resistant to 275 degrees Fahr.; slow burning to nonflammable; transparent. Used for ammunition components, laminated slot insulation for motors; spirally wound tubing is used for insulating tool handles and interior electrical parts.

Aero quality; cellulose-acetate base, specially developed for aircraft use in such applications as windows, cockpit enclosures, antennae housings, etc.; tough; has high clarity and optical uniformity; resistant to sunlight and can be heat-formed into three-dimensional shapes without surface impairment. Material now light stabilized, having greater weather resistance, and filtering out ultra-violet rays. It is abrasion-resistant.

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Type EC, ethyl cellulose, thermoplastic; furnished in powder form to be molded, machined and extruded; abrasion-resistant; resists corrosion caused by water, weak acids and alkalies; heat-resistant to 190 degrees Fahr.; flexibility, medium; dielectric strength, 250-500 volts per mil; tensile strength, 3000-9000 lb. per sq. in.; compressive yield, 2000-5000 lb. per sq. in.; low moisture absorption; available in colors; shatterproof; specific gravity, 1.07-1.15; translucent; opaque; used for aircraft venturi tubes, electrical and machinery parts.

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LUSTRON—Monsanto Chemical Co., Plastics Div., Springfield, Mass. Polystyrene; thermoplastic; styrene base; furnished in powder for molding into parts; abrasion resistance, fair; can be highly polished; corrosion-resistant; dielectric strength, 500-700 volts per mil; tensile strength, 5500-8500 lb. per sq. in.; low moisture absorption; available in color; specific gravity, 1.07; clear to opaque. Used for electrical insulating parts, etc.

See advertisement, Page 227

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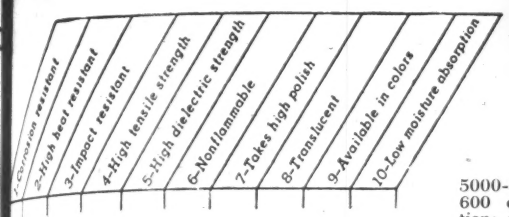
LUZERNE HARD RUBBER—The Luzerne Rub-



ber Co., Trenton, N. J. Hard rubber, thermoplastic; furnished in sheets, rods or tubes, for molding and machining into parts; high polish; corrosion-resistant to acids and alkalies; dielectric strength 6 x 10^2 megohms constant at 28.8 degrees Cent.; tensile strength, 3500-9000 lb. per sq. in.; heat-resistant to 120 degrees Fahr.; available in some colors; specific gravity 1.24; compressive strength, 8000-12,000 lb. per sq. in. Used for electrical, chemical, medical and other parts requiring high dielectric strength

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MASONITE — Masonite Corp., Chicago. Exploded wood fiber (lignin plastic); thermosetting, furnished in laminated form to be machined into parts; abrasion resistance, medium; heat-resistant to 450 degrees Fahr.; dielectric strength, 220 volts per mil; tensile strength, 7650 lb. per sq. in.; compressive, 26,000; moisture absorption, low; nonflammable; furnished in dark chocolate brown only; specific gravity, 1.36; opaque; can be highly polished; used in aircraft industry as pressure rings, templates, etc., also in communications field in telephone, radio and telegraph.

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MELMAC—Plastics Division, American Cyanamid Co., New York.

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P-592; melamine-formaldehyde, thermosetting material; for molding into parts; abrasion-resistant; resists corrosion caused by water or solvents; heat-resistant to 300 degrees Fahr.; flexibility, low; dielectric strength, 445 volts per mil; moisture absorption, low; opaque; nonflammable. Used where high arc resistance and high dielectric strength at elevated temperatures are required, such as aircraft ignition parts, circuit breakers, and cable connector inserts.

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P-3020; chopped, rag-filled, impact-resistance molding compound; used for heavy-duty circuit breakers.

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MICABOND—Continental-Diamond Fibre Co., Newark, Del. A built-up Mica material; furnished in sheets and tubing, for machining and forming into parts; heat-resistant; high dielectric and tensile strength; nonflammable; low moisture absorption. Used for V-rings, washers, segments and various special shapes.

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MICARTA—Westinghouse Electric & Mfg. Co., Trafford, Pa. Phenolic base, thermosetting; furnished in laminated sheet, rods or tubes; for molding, machining or stamping into parts; also special molded shapes; dielectric strength, 50-700 volts per mil depending upon grade; low moisture absorption; resistant to shock, corrosion; high polish; flexible; tensile strength, 6000-16,000 lb. per sq. in.; heat resistance, 230; nonflammable; specific gravity 1.32-1.8 depending upon grade. Used for bearings, gears, bushings, washers, thermal and electrical insulation and parts exposed to acids, alkalies and common solvents.

See advertisement, Page 115

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MULTIPLATE—Pittsburgh Plate Glass Co., Pittsburgh. Multiple laminated plate glass, Vinyl plastic binder; furnished in cut sizes and shaped; corrosion and abrasion resistance, high; shatterproof; transparent; highly polished; stops bullets from .50 caliber machine guns and smaller arms; for protection against high velocity missile.

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MYCALEX — General Electric Co., Pittsfield, Mass. Ceramic base thermoplastic; furnished in sheet, rods or tubes, or molded to specifications; for molding or machining into parts; abrasion resistance, moderate; can be highly polished; corrosion-resistant; dielectric strength, 350 volts per mil; tensile strength, 5000-7000 lb. per sq. in.; heat resistance, 600 degrees Fahr.; low moisture absorption; nonflammable; available in gray only; opaque; compressive strength, 22-30,000 lb. per sq. in.; used for electrical insulation, switches, etc.

See advertisement, Page 221

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NATIONAL CARBON—National Carbon Co. Inc., Carbon Products Div., Cleveland. Carbon or graphite in amorphous or graphite form; made in a variety of shapes; molded, extruded or machined into parts. In graphitic form carbon possesses excellent lubricating properties; highly resistant to most acids, alkalies and solvents. Used for sleeve bearings, packings, threaded parts, nozzles for corrosive liquids, pipe, fittings, valves, tubes, tower sections, etc. for the chemical and process industries.

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NATIONAL FIBRE—National Vulcanized Fibre Co., Wilmington, Del. Converted cotton cellulose, chemically pure, tough horn-like material; furnished in hard or flexible form in sheets, rolls, tubes, rods and fabricated shapes; high dielectric and mechanical strengths; resistant to abrasion and shock; easily formed and machined; light in weight. Used for gears, valve disks, gaskets, washers, bobbin heads, electrical insulation etc.

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NATIONAL SWITCH INSULATION — National Vulcanized Fibre Co., Wilmington, Del. Combination laminated Bakelite core with vulcanized fiber surfaces; available in sheets and fabricated shapes; high tracking (arc) resistance combined with rigidity and minimum warpage; high dielectric and mechanical strengths; low moisture absorption; easily stamped and fabricated. Used in switches to support and insulate current-carrying parts.

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NEILLITE—The Watertown Mfg. Co., Watertown, Conn. Phenolic base thermosetting material, furnished in powder form for molding into parts; abrasion resistance, medium; resists corrosion caused by weak acid and alkali; flexibility, 9000 lb. per sq. in.; dielectric strength, 300 volts per mil; tensile strength, 6000 lb. per sq. in.; compressive, 25,000 lb. per sq. in.; moisture absorption, low; nonflammable; available in colors; specific gravity, 1.36; shatterproof; for switch cases, spacers, etc.

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NEOPRENE—E. I. du Pont de Nemours & Co. Inc., Wilmington, Del. Chloroprene rubber; available as hose, wire, cable, sheets, tank linings, gaskets, packing, tubing, belting, diaphragms, industrial truck tires and molded goods. Used as binder for cork and asbestos. Is employed to impregnate or coat canvas, duck or other fabrics. Strength, abrasion resistance, resilience and elasticity of rubber; resistance to deterioration from contact with oils, greases, gasoline, heat, chemicals, sunlight and ozone; corrosion-resistant; will not support combustion; low moisture absorption; tensile strength 4000 lb. per sq. in.; available in colors. Used for machine applications where rubber characteristics are required but where the product is to be subjected to deteriorating influences.

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NIGRUM—Bound Brook Oil-Less Bearing Co., Bound Brook, N. J. Impregnated hardwood bearings and washers; northern hard maple impregnated with specially prepared lubricant; used in loose pulleys, automotive, textile, foundry equipment, etc.

See advertisement, Page 246

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NITRON—Monsanto Chemical Co., Plastics Div., Springfield, Mass. Cellulose-nitrate; thermoplastic; furnished in sheets, rods and tubes, or in laminated form, for machining, molding, stamping, swedging or blowing (steam) into parts; corrosion-resistant; translucent; available in colors; flexible; dielectric strength, 750-900 volts per mil; tensile strength, 6000-9000 lb. per sq. in.; low moisture absorption. Used for sight glasses, safety handles and structural models for strain study.

See advertisement, Page 227

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NYLON—E. I. du Pont de Nemours & Co. Inc., Arlington, N. J. Thermoplastic, furnished as monofilament for cutting into parts; abrasion resistance far superior to hog bristle; tough rather than brittle; resistant to many chemicals; very flexible; dielectric strength, (volts per unit) 5 at 1000 cycles, 20 degrees Cent.; tensile strength, 51,000 lb. per sq. in.; melting point, 264 degrees Cent.; nonflammable; produced in black and white; density, 1.14; translucent; used for brush bristles.

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OHMOID—Wilmington Fibre Specialty Co., Wilmington, Del. Phenolic base, thermosetting; furnished in laminated sheets, rods and tubes, for machining or stamping into parts; dielectric strength, 200-700 volts per mil; moisture absorption, 2 per cent; insoluble in ordinary solvents; high polish; corrosion-resistant; tensile strength, 10-14,000 lb. per sq. in.; heat resistance, 250-300 degrees Fahr. Used for electric and mechanical insulation.

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OPALON—Monsanto Chemical Co., Plastics Div., Springfield, Mass. Cast phenolic; thermosetting; furnished in sheets, rods and tubes, or laminated form; for casting and machining into parts; translucent; dielectric strength, 250-700 volts per mil; corrosion-resistant; tensile strength, 6000-11,000 lb. per sq in.; high polish; moisture absorption .05-.5 per cent; available in colors. Used for safety shields, clock and radio cases, electrically insulated knobs and handles and structural models for strain study, and decorative trim.

See advertisement, Page 227

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PANELYTE—Panelyte Division, St. Regis Paper Co., New York. Laminated resinous thermosetting plastics in sheets, rods, tubes, structural forms and molded shapes; supplied in fabric, paper, wood or asbestos base grades; parts fabricated or semifabricated to print. Various grades characterized by high strength, light weight, good electrical properties, excellent heat resistance, and freedom from odor. Unaffected by solvents, dilute acids and alkalies. Outstanding machinability, punchability and dimensional stability. Used in aircraft for propellers and propeller parts, air deflectors for engines, skin, fairings, inter-compartment doors and for high "EI" molded flooring. Also for radio and other electrical insulation applications, gears, pinions and nonstressed or semistressed structural parts, and in refrigeration for trim and structural parts.

See advertisement, Page 146

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PEERLESS — National Vulcanized Fibre Co., Wilmington, Del. Converted cotton cellulose, chemically pure, fish paper insulation; furnished in sheets and rolls; high dielectric strength combined with toughness, springiness and good bending properties. Used extensively for generator and motor insulation and various other electrical applications.

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PENN Vulcanized Fibre—Penn Fibre & Specialty Co., Philadelphia. Paper base material, furnished in sheet and rods or tubes, for machining or stamping into parts; abrasion resistance, low; resists corrosion caused by oils and grease; flexibility, low, and high when treated with glycerine; tensile strength, 6500-8500 lb. per sq. in.; compressive, 20-35,000; nonflammable; available in red, gray, white and black olive; shatterproof; specific gravity, 1.36-1.4; corrosion-resistant; for insulation, special gaskets, washers, special parts, dust-guards, pulleys, gears, etc.

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PERBUNAN—Stanco Distributors Inc., New York 4. Synthetic rubber, butadiene-acrylonitrile polymer, thermosetting material; furnished in sheets; for molding or extruding; abrasion resistance, medium; resists swelling by oil; heat-resistant to 300 degrees Fahr.; flexibility, high (-65 degrees Fahr.); dielectric constant, 15 at 60 cycles; tensile strength, 3500 lb. per sq. in. min.; moisture absorption, low; specific gravity, .96; trans-

1-Corrosion resistant
2-High heat resistant
3-Impact resistant
4-High tensile strength
5-High dielectric strength
6-Nonflammable
7-Takes high polish
8-Translucent
9-Available in colors
10-Low moisture absorption

lucent; machinability, good; for gaskets, packings, mountings, etc.

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PHENOL FIBRE—Penn Fibre & Specialty Co., Philadelphia. Phenolic base thermosetting material; furnished in sheets, laminated form, and in rods or tubes for machining and stamping into parts; abrasion resistance, high; resists corrosion caused by air, water, oils, light forms of acids; heat-resistant to 600 degrees Fahr.; flexibility, low; dielectric strength, 500 volts per mil; tensile strength, 8-12,000 lb. per sq. in.; compressive, 20-35,000; moisture absorption, low; nonflammable; shatterproof; available in natural, brown and black; specific gravity, 1.4; can be highly polished; for gears, bearings, washers, gaskets, special parts, insulation, pulleys, etc.

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PHENOLITE—National Vulcanized Fibre Co., Wilmington, Del. Laminated Bakelite; furnished with base of paper, cloth or asbestos in sheets, rods, tubes and fabricated shapes; also laminated with rubber sheet; high dielectric and mechanical strengths; low moisture absorption; heat-resistant; infusible; resistant to acids, solvents and oils; high resistance to wear and impact; machinable. Used in electrical, mechanical and chemical applications for silent gears, bearings, bushings, washers, valve disks, terminal strips, etc.

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PINCO Porcelain—The Porcelain Insulator Corp., Lima, N. Y. Ceramic base material; furnished in rods or tubes and special shapes, for molding and extruding; abrasion resistance, high; resists corrosion caused by contamination in air, oil pyronol, or most acids; flexibility, low; dielectric strength, 250 kv.—⅜-inch thickness and 170 kv.—1-inch thickness; tensile strength, 5000-8000 lb. per sq. in.; compressive, 100,000; moisture absorption, low; produced in color; specific gravity, 2.4; opaque; for pumps (acid) pipe-insulating bases, valves (acid), etc.

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PLASKON—Plaskon Division, Libbey-Owens-Ford Glass Co., Toledo.

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Urea-formaldehyde, thermosetting material; furnished in powder form for molding into parts; abrasion resistance, high; resists corrosion caused by weak acids and alkalies; heat-resistant to 170 degrees Fahr.; flexibility, low; dielectric strength, 300-400 volts per mil; tensile strength, 8000-13,000 lb. per sq. in.; compressive, 24,000-35,000; moisture absorption, medium; available in colors; specific gravity, 1.48-1.5; translucent. Used for housings, trim, knobs, dials, etc.

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Melamine-formaldehyde, thermosetting material, in powder form for molding; abrasion-resistant; resists corrosion caused by weak acids and alkalies; heat-resistant to 210 degrees Fahr.; dielectric strength, 300-400 volts per mil; tensile strength, 8000-13,000 lb. per sq. in.; compressive, 25,000-35,000; available in colors; specific gravity, 1.48-1.5; translucent.

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PLASTACELE—E. I. du Pont de Nemours & Co. Inc., Wilmington, Del. Cellulose-acetate base, thermoplastic; furnished in powder, sheets, rods and tubes, for machining and molding into parts; available in colors; transparent; resistant to shock; high polish; corrosion-resistant; flexible; dielectric strength, 700-1000 volts per mil; tensile strength, 3000-8000 lb. per sq. in.; heat resistance, 185-250 degrees Fahr. Used for machine guards, models, control panels, dials, knobs, steering wheels, safety glass screens, etc.

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PLASTIKFLEX—R. D. Werner Co. Inc., New York. Flexible tubing, thermoplastic; to be extruded; used for conduits, insulation, hose, fuel lines, hospital equipment, sleeving, spacers, stirrup pumps, gaskets, gages, (square tubing for dehydration), etc.

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PLASTROX "B"—Ingersoll Plastics Co., New York. Fibrous, thermosetting material, furnished in laminated sheet and powder form; for molding; abrasion resistance, medium; resists corrosion caused by oil; heat-resistant to 1700 degrees Fahr.; flexibility, low; moisture absorption, medium; shatterproof; opaque; for pans, gaskets, washers, heat insulators, fluorescent light reflectors, etc.

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PLAX POLYFLEX—Plax Corp., Hartford, Conn. Thermoplastic furnished in laminated sheets; for molding and machining into parts; abrasion resistance, low; resists corrosion caused by acids, alkalies and alcohol; heat-resistant to 85 degrees Cent.; flexibility, medium, dielectric strength, 2500-4000 volts per mil; tensile strength, 7000-10,000 lb. per sq. in.; moisture absorption, low; shatterproof; specific gravity, 1.04; transparent; machinability, good; for electronic parts, covers, etc.

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PLAX POLYSTYRENE—Plax Corp., Hartford, Conn. Thermoplastic furnished in sheets, rods or tubes; for machining, stamping and extruding into parts; abrasion resistance, low; resists corrosion caused by acids, alkalies and alcohol; heat-resistant to 85 degrees Cent.; flexibility, low; dielectric strength, 500-2500 volts per mil; tensile strength, 5000-7000 lb. per sq. in.; moisture absorption, low; specific gravity, 1.04; for electronic and electrical insulators.

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PLEXIGLAS—Rohm & Haas Co., Philadelphia 5. Acrylic base, thermoplastic; furnished in sheets and rods; corrosion and shock-resistant; transparent; flexible; specific gravity 1.18; tensile strength, 5800-8000 lb. per sq. in.; available in colors; high polish. Used for unbreakable inspection windows, dial covers, etc.

See advertisement, Page 125

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PLUSWOOD—Pluswood Inc., Oshkosh, Wis. Resin-impregnated plywood, heated by high frequency waves and simultaneously compressed under heavy pressure. Furnished in any desired thickness, in large or small sheets, in natural dark deep brown color. Has wood grain with high gloss finish; high density; lightweight; and is resistant to exposure. It can be sawed, drilled, turned, threaded, milled and tapped; nonflammable; highly resistant to decay, acids, alcoholic mixtures and other organic liquids. Specific gravity, 1.3-1.4; tensile strength (parallel laminated in fiber direction), 32-40,000 lb. per sq. in.; compressive strength, 20-28,000; impact strength (Izod), 6-8 lb. per inch of notch. For use as exhaust and blower fan blades, and in boat-building, aircraft and automotive industries.

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PLYMETL—Haskelite Mfg. Corp., Grand Rapids 2, Mich. Resin-bonded plywood, sheet metal bonded to one or both faces; has stiffness, rigidity; lightweight; metal on both faces insuring freedom from warpage. Types available for different purposes are galvannealed steel, stainless steel, aluminum, copper, chrome zinc, chrome steel, porcelain, etc. Used for applications in the automotive and railroad fields.

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PLYMOLD—Haskelite Mfg. Corp., Grand Rapids 2, Mich. Resin-bonded plywood, molded in simple or compound curvatures.

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POLAROID—The Polaroid Corp., Cambridge, Mass. Light-polarizing glass and film. Principal property is 99.5 per cent polarization of transmitted light, uniformly over large area. Used for camera filters, polarizing attachments for microscopes, polarimeters, and other scientific instruments. Also for polariscopes to determine strain, three-dimensional motion picture apparatus, glareless auto headlights, nonpolarizing colored filters, etc.

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PREGWOOD—Formica Insulation Co., Cincinnati. Phenolic, impregnated, laminated, densified wood; thermosetting; for machining and pressing; abrasion resistance, high; heat-resistant to 175 degrees Fahr.; flexibility low; dielectric strength, 200 volts per mil; tensile strength, 30,000 lb. per sq. in.; compressive, 20,000 lb. per sq. in.; moisture absorption, low; inflammable; shatterproof; opaque; can be highly polished; for use as switch gear, instrument plates, fan and propeller blades, etc.

See advertisement, Page 135

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PRESTITE—Westinghouse Electric & Mfg. Co., Derry, Pa. Ceramic base material furnished in rods or tubes for molding into parts; abrasion resistance, high; resists corrosion caused by everything except hydrofluoric acid; heat-resistant to 1450 degrees Fahr.; dielectric strength, 340 volts per mil; tensile strength, 5000 lb. per sq. in.; compressive, 48,000; no moisture absorption; nonflammable; available in any ceramic glaze; specific gravity, 2.4; opaque; for some die and sand castings, and as a substitute for phenolic plastics.

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PVA—E. I. du Pont de Nemours & Co., Wilmington, Del. Thermoplastic, polyvinyl alcohol. Material is furnished in powder form for molding and casting and used as an emulsifying agent, also in the preparation of grease, oil and solvent-resistant rubber substitutes, textile sizings, paper coatings, and adhesives. Is highly flexible; low dielectric strength; heat resistance up to 212 degrees Fahr.; takes color; shatterproof; specific gravity, 1.3 powder; translucent; resistant to organic solvents. Used for oil-resistant gaskets, tubes, rollers, etc., as well as protective coatings on metal parts.

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PYRALIN—E. I. du Pont de Nemours & Co. Inc., Wilmington, Del. Nitrocellulose base, thermoplastic; furnished in sheets, rods and tubes, for machining into parts; transparent; available in colors; shock and corrosion-resistant; high polish; flexible; dielectric strength, 300-750 volts per mil; tensile strength, 5000-10,000 lb. per sq. in. Used for handles, gage glasses, instrument covers, models, safety glass screens, etc.

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PYREX—Corning Glass Works, Corning, N. Y. Glass products such as tubing, cylinders, sheets, molded parts, etc., covering a wide range of chemical, physical and optical properties such as heat resistance, low or high thermal conductivity, low or high coefficient of expansion, excellent corrosion resistance; no appreciable moisture absorption; nonflammability; ability to bond to metal. Over 250 glasses regularly melted. Specific properties of typical product PYREX brand piping, as follows: Linear coefficient of expansion .0000018 in. per deg. Fahr. between 66-660 degrees Fahr. Thermal conductivity 8.1 B.t.u./sq. ft. /hr./in. deg. Fahr. at 77 degrees Fahr. Tensile strength, 6000-10,000 lb. per sq. in.; dielectric strength, very high.

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PYROPLAX—Cutler-Hammer Inc., Milwaukee. Asbestos base; furnished in cold-molded pieces; heat resistance, 800-1000 degrees Fahr.; nonflammable; dielectric strength, 40 volts per mil; resistant to corrosion and abrasion. Used for machine parts where resistance to high temperature is needed.

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REANITE—The United States Stoneware Co., Akron, O. Resinous base, thermosetting material, furnished in liquid form, for bonding metals to metals or rubber and plastics to metals; abrasion resistance, medium; resists corrosion caused by acids and alkalies; heat-resistant to 300 degrees Fahr.; flexibility, high; tensile strength, 3000 lb. per sq. in.; moisture absorption, low; shatterproof; available in black only; opaque.

See advertisement, Page 239

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RESILON—The United States Stoneware Co., Akron, O. Resinous thermoplastic; furnished in sheets and lumps to be molded and cast into machine parts; corrosion-resistant; flexible; high dielectric strength. Used for lining parts to resist corrosive attack.

See advertisement, Page 239

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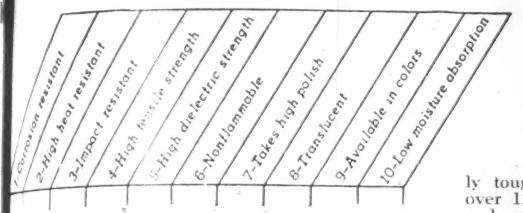
RESINOX—Monsanto Chemical Co., Plastics Division, Springfield, Mass. Phenolic molding



ing compounds, in standard and special formulas, thermosetting; heat-resistant; specific gravity, 1.44; flexural strength, 9200 lbs. per sq. in.; tensile strength, 6800 lb. per sq. in.; impact strength, 2.5 ft. lb. per sq. in.; water absorption, .63 per cent by weight. Used in electrical equipment large housings, radio cabinets, etc. This tradename also refers to phenolic impregnating and treating resins.

See advertisement, Page 227

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RESISTOFELT—Western Felt Works, Chicago. A lamination of high-grade wool felt and Neoprene. Used on revolving shafts; the felt lubricates the shaft and prevents entrance of dust; the Neoprene prevents passage of oil.

See advertisement, Pages 237, 246

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RESISTOFLEX—Resistoflex Corp., Belleville, N. J. Synthetic resin base, thermoplastic, furnished in sheet and laminated form, and in rods or tubes for molding or extruding; abrasion resistance, high; resists corrosion caused by oils, gasoline, and organic solvents; heat-resistant to 275 degrees Fahr.; flexibility, high; dielectric strength, 10.7 volts per mil; tensile strength, 5236 lb. per sq. in.; moisture absorption, medium; available in color; shatterproof; specific gravity, 1.259; transparent; for diaphragms, gaskets, oil hydraulic and lubricating hose assemblies.

See advertisement, Page 251

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RESNPREST—Plylock Corp., subsidiary of M & M Wood Working Co., Portland, Ore. Phenol-formaldehyde bonded plywood; thermosetting; strong by unit weight; panel ¼-inch thick and 12-in. sq. weighs approximately 12 oz. and supports over 400 lb.; panels to 9 inches thick can be furnished if desired, widths to 72 inches (sanded) or 96 inches (unsanded); lengths to 144 inches; special scarfed panels to 36 ft. Cross-ply construction of material makes it splitproof and nails and screws can be fastened to very edge with safety. Resists heat and cold; and has low moisture absorption. Used wherever rigidity and lightweight is needed. Guaranteed against ply separation.

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REVOLITE—Atlas Powder Co., Zapon-Keratol Div., Stamford, Conn. Cloth base impregnated with Bakelite resin; in either laminated or single ply form; heat-resistant; high dielectric strength; corrosion-resistant; low moisture absorption; impact-resistant. Used for cable wrappings, diaphragms for pumps and valves, gaskets and flexible connections for machinery such as pulverizers, and coated asbestos laundry roll covers for flat work ironers.

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RUB-EROK—The Richardson Co., Melrose Park, Ill. Special rubber furnished in sheet form; corrosion-resistant; high dielectric strength; low moisture absorption; low loss factor. Used for electrical insulation.

See advertisement, Page 126

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RUB-TEX—The Richardson Co., Melrose Park, Ill. Hard rubber molded into parts, particularly desirable for electrical, heat and cold insulation; for industrial uses.

See advertisement, Page 126

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RYERTEX—Joseph T. Ryerson & Son Inc., Chicago. A nonmetallic bearing material designed for use with water lubrication primarily; high shock resistance; suitable for bearing loads to 5000 lb. per sq. in.; resistant to acids and mild alkalies.

See advertisement, Page 236

S

SAFLEX—Monsanto Chemical Co., Plastics Division, Springfield, Mass. Polyvinyl acetal thermoplastic sheet material, used as an interlayer in laminated safety glass; extremely tough from temperatures below zero to over 120 degrees Fahr. Has great flexibility and rubberiness. Dopes and coatings available in curing types.

See advertisement, Page 227

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SARAN—The Dow Chemical Co., Midland, Mich., and licensees. Crystalline, thermoplastic, fibrous, aliphatic chloride, polymeric base; furnished in special extruded and molded fabricated forms; corrosion-resistant; very tough and flexible; tensile strength, to 50,000 lb. per sq. in. (extruded); no moisture absorption; abrasion-resistant; takes high polish; high dielectric strength; shatterproof; nonflammable; available in color; transparent to opaque. Used for moldings, gaskets, packings, tubing, belting, etc. Licensees: Acadia Synthetic Products Div., Western Felt Works, Chicago; Allied Plastics Co., Los Angeles; Detroit Macoid Corp., Detroit; Elmer E. Mills Corp., Chicago; Extruded Plastics Inc., Norwalk, Conn.; Firestone Tire & Rubber Co., Akron, O.; Hodgman Rubber Co., Framingham, Mass.; Irvington Varnish & Insulator Co., Irvington, N. J.; National Plastic Products Co., Baltimore; Parker Appliance Co., Cleveland; Pierce Plastics Inc., Bay City, Mich.; J. L. Skuttle Co., Detroit; St. Louis Plastic Molding, St. Louis; Standard Products Co., Detroit; Yardley Plastics Co., Columbus, O.

See advertisement, Page 155

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SIRVENE—Chicago Rawhide Mfg. Co., Chicago. Synthetic rubber compounds molded into parts; resistant to oils and heat, oxidation and weather. Used for sealing oils and greases, packings, gaskets, covers and special parts.

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SIRVIS—Chicago Rawhide Mfg. Co., Chicago. Special tanned abrasive and heat-resisting leather. Used for all types of packings, gaskets and mechanical leather parts.

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SPAULDING ARMITE—Spaulding Fibre Co. Inc., Tonawanda, N. Y. Hard vulcanized fibrous material (fish paper); sheets and rolls for stamping or forming into parts; flexible; dielectric strength, 200-550 volts per mil; abrasion and corrosion-resistant; tensile strength, 9000-15,000 lb. per sq. in.; highly polished.

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SPAULDING FIBRE—Spaulding Fibre Co. Inc., Tonawanda, N. Y. Hard vulcanized fibrous material; sheets, rods and tubes, for machining, stamping or forming into parts; dielectric strength, 150-400 volts per mil; tensile strength, 9000-15,000 lb. per sq. in.; available in colors; resistant to shock. Used for mechanical and electrical applications where toughness, lightweight and machining and forming properties are essential.

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SPAULDITE—Spaulding Fibre Co. Inc., Tonawanda, N. Y. Phenolic base, thermosetting; furnished in laminated sheets, rods and tubes for machining or stamping into parts; dielectric strength, 700 volts per mil; low moisture absorption; high polish; corrosion and heat-resistant (220 degrees Fahr.); resistant to shock. Used for electrical insulation and where resistance to moisture and chemicals, appearance and permanence are essential.

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SPAULDO—Spaulding Fibre Co. Inc., Tonawanda, N. Y. Fibrous material; furnished in sheets and rolls, for machining or stamping into parts; flexible; dielectric strength, 300 volts per mil; heat resistance, 220 degrees Fahr.; high polish; corrosion-resistant; tensile strength, 5000-16,000 lb. per sq. in.; resistant to shock. Used for applications where flexibility and toughness in both grain directions are essential.

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STEATITE—General Ceramics & Steatite Corp., Keasbey, N. J. Ceramic material furnished in finished parts, or for molding, casting, machining, extruding and pressing; abrasion resistance, high; resists corrosion caused by alkalies and acids; heat-resistant to 1800 degrees Fahr.; dielectric strength, 300 volts per mil; tensile strength, 9500 lb. per sq. in.; compressive, 81,000; moisture absorption, none; produced in white; impact resistance, 2.27 lb. per sq. in.; specific gravity, 2.7; opaque; for light bearings, radio frequency insulating parts, etc.

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STRUCTOMOLD—McDonnell Aircraft Corp., St. Louis. Phenolic paper laminate, thermosetting; furnished in laminated form; abrasion resistance, medium; resists corrosion caused by all acids except alkalies and oxidizing acids; heat-resistant to 300 degrees Fahr.; flexibility low; dielectric strength, 500 volts per mil; tensile strength, 25,000 lb. per sq. in.; compressive, 18,000; moisture absorption, low; available in color; specific gravity, 1.35-1.4; opaque; machinability, fair; used for handles, platens, nameplates, guards, electrical connector blocks, etc.

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STUPAKOFF No. 621—Stupakoff Ceramic & Mfg. Co., Latrobe, Pa. Steatite ceramic furnished in finished form or for molding, casting, machining, stamping, extruding. Abrasion resistance, high; resists corrosion caused by acid and alkalies, except hydrofluoric acid; dielectric strength, 200 volts per mil, inst.; tensile strength, 9000 lb. per sq. in.; compressive, 75,000; moisture absorption, low; available with colored glaze; specific gravity, 2.6; opaque; for electrical insulating parts.

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STYRALOY 22, 22-A—Dow Chemical Co., Midland, Mich. Synthetic elastomer furnished as molding powder. Excellent low temperature flexibility to -75 degrees Cent.; high dielectric strength; low power factor, high insulation resistance. Tensile strength, 1000 lb. per sq. in.; elongation at break 250 per cent; good abrasion resistance. Low moisture absorption. Dark blue, translucent. Used for wire coating, electrical insulation; can be extruded, injection or compression molded.

See advertisement, Page 155

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STYRON NA, LA, GA and CA—Dow Chemical Co., Midland, Mich. Thermoplastic; furnished in granules for molding; high clarity; corrosion-resistant; dielectric strength, 5000 volts per mil at 1 mill, 500 volts per mill at 125 mil; tensile strength, ult., to 10,000 lb. per sq. in.; low moisture absorption; low flammability; available in color; transparent. Used for insulators, decorative articles, structural parts, general injection molding, etc.

See advertisement, Page 155

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SWEET HOME BRAND—Am-mex Sales Co. Inc., Buffalo. Phenolic resin-bonded, thermosetting plywood, machined into parts. Used for aircraft cabinets, instrument panels, bases, bodies, boats, etc.

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SYNTHANE—Synthane Corp., Oaks, Pa. Phenolic, thermosetting materials, corrosion-resisting; furnished in sheets, rods and tubes, fabricated parts, and in parts made by molding the impregnated base materials. Available in following grades:

X; Kraft paper base, hard resin, laminated material; for mechanical applications where electrical requirements are of secondary importance; tensile strength, 12,500 lb. per sq. in.

XP; Kraft paper base, plasticized resin, laminated material, primarily intended for punching; more flexible and not quite as strong as Grade X; moisture resistance and electrical properties intermediate between Grades X and XX.

XX; cotton rag paper base laminated material; hard, greater percentage of resin than Grade X; suitable for usual electrical applications; good machinability.

XXP; cotton rag paper base laminated material; similar to Grade XX in electrical and moisture-resisting properties, but more suitable for hot punching. Intermediate between Grades XP and XX in punching and cold flow characteristics.

XXX; cotton rag paper base laminated material; suitable for radio frequency work, for high humidity applications; minimum cold flow characteristics.

XXXP; cotton rag paper base laminated material; similar to Grade XXX but with lower dielectric losses and more suitable for hot punching; greater cold flow than Grade XXX, and intermediate between Grades XXP and XXX in punching characteristics.

C; heavy weave fabric; base laminated material made throughout from cotton fabric weighing over 4 oz. per sq. yd., and having a

count of not more than 72 threads per inch in the filler direction, nor more than 140 threads per inch total in both warp and filler direction. Strong, tough material suitable for gears and other applications requiring high impact strength. Available in subgrades, depending upon sizes of gears and types of mechanical service. Should not be used for electrical applications.

CE; heavy weave fabric base laminated material, same as Grade C; for electrical applications requiring greater toughness than Grade XX, or mechanical applications requiring greater resistance to moisture than Grade C.

L; fine weave fabric base laminated material, of cotton; suitable for small gears and other fine machining applications, particularly in thickness under ½-inch. Not quite as tough as Grade C; should not be used for electrical application except for low voltage.

LE; fine weave fabric base laminated material, same as Grade L; for electrical applications requiring greater toughness than Grade XX; better machining properties and finer appearance than Grade CE; also available in thinner sizes; exceptionally good in moisture resistance.

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SYNTOFLEX—Felt Products Mfg. Co., Chicago.

R 203 reclaim rubber, for pads for use under headlights, tail-lights and all attachments on body; for electrical conduit work, or for gaskets for water applications and other non-severe conditions where a soft seal is required.

HN-178; in plain gasket form only, for more severe conditions such as contact with oil, aromatic fuels, gasoline and other chemicals.

BVR 513; rubberized strip material, for use as alternate to sponge rubber strip material, consisting of felt base specially impregnated with spongy characteristics of sponge rubber stripping. Available in various shapes and in lengths up to 6 feet.

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TAYLOR FIBRE—Taylor Fibre Co., Norristown, Pa. Phenolic base, thermosetting; furnished in laminated sheet, rods or tubes for machining into parts; high polish; flexural strength, 12,000-16,000 lb. per sq. in.; dielectric strength, 500 volts per mil; tensile strength, 5000-9000 lb. per sq. in.; heat resistance, 300 deg. Fahr.; low moisture absorption; available in colors; impact-resistant; brinell hardness, 35-45. Used for gears, and insulating and binding material against moderate temperatures.

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TEGIT—Garfield Mfg. Co., Garfield, N. J. Tan colored, cold-molded plastic; corrosion-resistant; high dielectric strength; moisture absorption less than 1 per cent; heat resistance, 300 degrees Fahr.; impact-resistant; resists hot oil, boiling water and ordinary chemicals; will not shrink, crack, warp or deteriorate with age. Used for heavy-duty wiring devices and small insulated parts.

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TEGO—Resinous Products & Chemical Co., Philadelphia 5. A synthetic resin (adhesive) phenolic resin film, dry sheet. Has low moisture absorption, high density; used in manufacture of waterproof plywood for aircraft and marine use.

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TENITE—Tennessee Eastman Corp., Kingsport, Tenn.

I; cellulose-acetate base, thermoplastic; furnished in granular and molding sheet form; available in clear transparent and colors, plain, variegated, translucent and opaque; high impact strength; high polish. Used for compression and injection molding decorative and industrial products, also extruded in form of strips, rods and tubes.

II; cellulose-acetate butyrate base, thermoplastic; furnished in granular and molding sheet form; has greater dimensional stability than cellulose acetate plastic because of lower moisture absorption; contains less plasticizer than cellulose acetate plastic and the plasticizer used has greater retentivity; available in clear transparent and colors; plain, variegated, translucent and opaque; high impact strength; high polish. Used for compression and injection molding of decorative and industrial products, also extruded in form of strips, rods and tubes.

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TENSILASTIC—American Wringer Co. Inc., Woonsocket, R. I. Hard and soft rubber and rubber synthetics for rolls and linings and covering of tank parts, etc. Available in any size from ½-inch long and ½-inch in diameter to 300 inches long and 44 inches in diameter; any density from dead hard to very soft; compounded to meet mechanical and chemical requirements; heat-resistant to 180 degrees Fahr.; flexibility, high; moisture absorption, low.

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TEXRUB—M. B. Price Associates, New York. Rubber-like, vinyl base, thermosetting and thermoplastic materials, furnished in laminated sheets, rods or tubes; for molding, casting, machining, stamping and extruding into parts; abrasion resistance, high; resists corrosion caused by water, gas, oils, alkalies, uric acid and 30 per cent sulphuric acid and ozone; softens at 240 degrees Fahr.; melts at 330; flexibility, good; tensile strength, 2500 lb. per sq. in.; available in black, white, gray, red, brown and green; translucent and opaque; shatterproof; specific gravity, 1.26; used for chemical tubing and piping, etc.

1 2 3 4 - - - - - -

TEXTOLITE—General Electric Co., Plastics Divisions, Pittsfield, Mass. Phenolic, urea cellulose bases, thermosetting and thermoplastic materials; compression, injection and transfer molded, laminated, molded laminated, sheets, rods, tubes, bearings, fabricated parts; abrasion and corrosion resistant; tensile strength, 3500-20,000 lb. per sq. in.; dielectric strength 60-1000 volts per mil; heat resistant 140-450 degrees Fahr.; resistant to shock; flexible in some grades; available in color; takes high polish; translucent in some grades; specific gravity 1.07-2.03. Used for electrical or thermal insulation, structural parts, gears, cams, bearings, housings, knobs, etc.

1 2 - 4 - - - - - -

Cold Molded—Two types: nonrefractory material containing asphalt as a binder and asbestos as a filler and refractory containing cement and drying oils as a binder with an asbestos filler; cold molded at room temperatures and heat treated for strength and toughness; corrosion-resistant; heat and arc-resistant. Not recommended for parts requiring high electric strength or thin sections.

See advertisement, Page 221

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THERMOPANE—Libbey-Owens-Ford Glass Co., Toledo, O. Glass metal edge-sealed with dehydrated dead-air space; furnished in flat units; abrasion resistance, high; resists corrosion; heat-resistant to 150 degrees Fahr.; flexibility, low; dielectric strength, .204 kilovolts per mil; tensile strength, 6000-36,000 lb. per sq. in.; compressive, 3000-100,000; nonflammable; moisture absorption, low; specific gravity, 2.52; transparent and translucent; for insulated observation windows.

See advertisement, Page 225

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THERMOPLAX—Cutler-Hammer, Inc., Milwaukee. Bituminous base compounded with filler such as asbestos; cold-molded into parts; heat resistance, 400-600 degrees Fahr.; nonflammable; dielectric strength, 80-100 volts per mil; resistant to corrosion; takes high polish; tensile strength, 2000-4000 lb. per sq. in.; moisture absorption, 2 per cent. Used for electrical and heat insulation.

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THIOKOL—Thiokol Corp., Trenton, N. J. Synthetic rubber, available in three types: Crude, corresponding to crude rubber, water dispersions for coatings, and molding powders; processed in manner similar to rubber; oil corrosion and solvent-resistant. Used for hoses carrying oil or gasoline, gaskets, packing, pipeline rings, diaphragms, newspaper printing blankets, etc.

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TRANSFLEX—Irvington Varnish & Insulator Co., Irvington, N. J. Transparent, flexible extruded plastic tubing which when used as conduit permits quick identification of coded enclosed leads and location of wire breaks, unusual elongation facilitates stretching over lugs, splices and other projections; does not become brittle at temperatures as low as —58 degrees Fahr. Dielectric strength, 1200 volts per mil dry, 1000 volts per mil wet—for tubing wall thickness approx. .020-inch.

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TUF-FLEX—Libbey-Owens-Ford Glass Co., Toledo, O. Polished plate glass heat tempered, furnished in sheet and laminated form, resists corrosion caused by moisture and all common acids except hydrochloric acid; heat-resistant to 550 degrees Fahr.; flexibility, medium; dielectric strength, .204 kilovolts per mil; tensile strength, 36,000 lb. per sq. in.; compressive, 50-100,000 lb. per sq. in.; not shatterproof but 5-7 times stronger than plate glass; produced in clear and colors; specific gravity, 2.5; for machine guards, observation and inspection windows, sight glasses, gage glasses, etc.

See advertisement, Page 225

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TULOX—Extruded Plastics Inc., Norwalk, Conn.

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TT; thermoplastic, furnished in rods or tubes for extruding; medium abrasion resistance, heat-resistant to 160 degrees Fahr.; flexibility, low; tensile strength, 4-5000 lb. per sq. in.; low moisture absorption; available in color; specific gravity, 1.2; shatterproof, transparent; translucent; opaque; machinability, good; for use as gage glasses and small screw machine parts, separators, etc.

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V series; thermoplastic, furnished in rods or tubes for extruding; high abrasion resistance, resists corrosion caused by most chemicals, heat-resistant to 150 degrees Fahr.; flexible, dielectric strength (.025-inch thick) 1100 volts per mil; tensile strength, 1500 lb. per sq. in.; low moisture absorption; available in color, shatterproof; for insulation.

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TYGON—The United States Stoneware Co., Akron, O. Synthetic resin, thermoplastic, furnished in flexible or rigid sheets, tubing, rods, or in liquid form; may be molded cast or extruded. Abrasion, impact and corrosion-resistant; unaffected by oil, gasoline, water, nonaging; high dielectric and tensile strength. May be transparent, translucent or opaque, available in colors. Nontoxic.

See advertisement, Page 239

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UFORMITE—Resinous Products & Chemical Co., Philadelphia 5. A synthetic resin (adhesive) urea-formaldehyde; furnished in powder form; has low moisture absorption, high density; used in manufacture of waterproof plywood for aircraft and marine use.

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UNISORB—Felters Co. Inc., Boston. Specially controlled felt for vibration absorption. Types and thicknesses available for most frequencies and loadings encountered in industrial field. Also types available for sound absorption. Petroleum-resistant. A special brand cement is also available for use with this material in order to eliminate the need of any other form of hold down such as expansion bolts or lag screws. Holding strength in excess of 40 lb. per sq. in. when used between the felt and steel, concrete or wood.

See advertisement, Page 222

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U. S. RUBBER—U. S. Rubber Co., New York. A synthetic rubber for hose, belts, packings, molded goods, tank linings, and other uses.

See advertisement, Page 133

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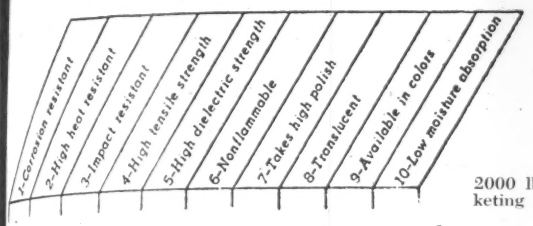
"U. S." STANDARD—The United States Stoneware Co., Akron, O. Acid-proof chemical stoneware available in a wide range of shapes and sizes; resists all corrosives except hydrofluoric acid and hot caustics; for fabrication into tanks, etc., and for lining exhausters and acid-pumps. Hard, durable, available in heat-shock resistant bodies.

See advertisement, Page 239



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UNIVERSAL PORCELAIN—The Universal Clay Products Co., Sandusky, O. Ceramic base material for molding into parts; resists corrosion caused by acids, climatic exposure and fumes, with the exception of hydrofluoric acid; heat-resistant to 500 degrees Fahr.; moisture absorption, low; available in color; specific gravity, 1.2 opaque; for use in electric insulation.

V

VIBRACORK—Armstrong Cork Co., Lancaster, Pa. Resilient board of cork granules; compressed and baked under pressure; long life and high resistance to deterioration. Material is made in three densities for vibration damping applications.

See advertisement, Page 224

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VICTOLENE—Victor Mfg. & Gasket Co., Chicago. Synthetic rubber compound, thermosetting material, furnished in sheets and stampings, for molding into parts; resists corrosion caused by oil, gasoline, kerosene, salt water and antifreezes; heat-resistant to 250 degrees Fahr.; flexibility, high; tensile strength, 350 lb. per sq. in.; compressive, .038-inch for stock—.190-inch under 2960 lb. per sq. in.; moisture absorption, medium; inflammable; available in brown; shatterproof; specific gravity, 1.12; opaque; for gasketing material, when compressed in position by light metal or plastic stampings, used for sealing fluids.

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VICTOPAC—Victor Mfg. & Gasket Co., Chicago. Compressed sheet packing with asbestos base for stamping or cutting by hand into parts; high corrosion resistance; flexibility; tensile strength, 2500 lb. per sq. in.; heat-resistant; low moisture absorption; nonflammable; impact-resistant; high compressive strength. Used for gasketing and packing.

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VICTOPRENE—Victor Mfg. & Gasket Co., Chicago. Synthetic elastic, thermosetting; furnished in sheet or molded form. Sheets may be stamped and blanked into parts; corrosion and heat-resistant; tensile strength, 1500 lb. per sq. in.; low moisture absorption; shatterproof. Used as a gasketing material.

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VICTOR—Victor Mfg. & Gasket Co., Chicago.

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Asbestos sheet, asbestos fiber base; furnished in sheets for stamping or cutting into parts; corrosion-resistant; flexible; tensile strength, 300 lb. per sq. in.; heat resistance, 700 degrees Fahr.; nonflammable; specific gravity, .9; high compressive strength; insoluble; some resilience. Used for packing, thermal insulation, and vibration absorption.

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Cork sheet; vegetable bark in sheet form for stamping and cutting into parts; corrosion-resistant; flexible; heat resistance, 180 degrees Fahr.; low moisture absorption; specific gravity, .27; fair compressive strength; resilient. Used for seals, vibration absorption.

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VICTORITE—Victor Mfg. & Gasket Co., Chicago. Vegetable fiber base, sheet packing; furnished for stamping or cutting by hand into machine parts; flexible; tensile strength, 3000 lb. per sq. in.; heat resistance, 200 degrees Fahr.; nonflammable; impact-resistant; specific gravity, .675; compressive strength, 2000 lb. per sq. in.; resilient. Used for gasketing and packing.

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VINYLITE—Carbide & Carbon Chemicals Corp., New York.

Unfilled V series: conjoint polymer of vinyl chloride and vinyl acetate; thermoplastic; furnished in sheets, rods or tubes, elastic sheeting, powder for molding, machining, heat forming, stamping or extruding into parts; corrosion-resistant; takes high polish; flexible; available in colors; nonflammable; moderate tensile strength; dielectric strength 650 volts per mil. Used for machine cabinets, electrical fixtures, transparent windows, dials, drawing and calculating instruments.

Resins: Series "A" (polyvinyl acetates) granular form, and in solution, thermoplastic. Adhesives applied as hotmelt or from solution for metal to metal, metal to glass, etc. Series "X" (polyvinyl acetal) in powder and sheet form, thermoplastic.

Laminated film for safety glass.

Series "Q" (polyvinyl chloride) in powder form.

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VISTANEX—Stanco Distributors Inc., New York 4. Nonvulcanizing plastic, isobutylene polymer base material, furnished in sheets; for molding or extruding; abrasion resistance, medium; resists corrosion caused by acids, alkalies and oxidation; flexibility, low; dielectric constant, 2.2 at 1000 cycles; tensile strength, 1500 lb. per sq. in.; moisture absorption, low; specific gravity, .91; translucent; machinability, poor; for electrical insulation, etc.

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VITALIC—Continental Rubber Works, Erie, Pa. Molded, extruded and lathe-cut mechanical rubber products including hose, fan belts, and all types of industrial rubber goods.

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VITRIC-10—The United States Stoneware Co., Akron, O. Ceramic-base, nonplastic; furnished in powder form for casting into parts, or as complete parts; corrosion and heat-resistant (1000 degrees Fahr.); nonflammable. Available in colors; used for cementing and sealing.

See advertisement, Page 239

- 2 3 - - - - 8 - -

VITROLUX—Libbey-Owens-Ford Glass Co., Toledo, O. Polished plate glass, heat-tempered, ceramic enamel color-fused; furnished in sheet or laminated form; abrasion resistance, medium; resists corrosion caused by all common acids; heat-resistant to 550 degrees Fahr.; flexibility, medium; dielectric strength .204 kilo volts per mil; tensile strength, 36,000 lb. per sq. in.; compressive, 50-100,000 nonflammable; available in colors; not shatterproof but 5-7 times stronger than plate glass; specific gravity, 2.5; translucent and opaque types.

See advertisement, Page 225

- 2 - 4 5 - - - - -

VULCABESTON—Colt's Patent Fire Arms Mfg. Co., Hartford, Conn. Hard rubber, or Neoprene and asbestos base, thermosetting; furnished in sheet and laminated forms or rods and tubes for machining into parts or supplied as complete parts; heat resistance, 750 degrees Fahr.; tensile strength, 7000 lb. per sq. in.; dielectric strength, 40 volts per mil; corrosion-resistant; low moisture absorption. Uses include insulation, brake linings, etc.

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VULCOID—Continental-Diamond Fibre Co., Newark, Del. Resinous base, thermoplastic; furnished in sheets and laminated forms, or rods and tubes for machining, stamping or forming into parts; low moisture absorption; dielectric strength, 400 volts per mil; tensile strength, 11,000 lb. per sq. in.; resistant to abrasion; flexible in some forms; heat resistant to 275 degrees Fahr.; available in red, gray, black; nonflammable; shatterproof. Used for insulation where arc resistance and moderate moisture resistance are important.

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VULPRENE—American Resinous Chemicals Corp., Peabody, Mass. Synthetic rubber-soya, thermosetting material; furnished in sheets and powder; for molding and extruding. Abrasion resistance, low; resists corrosion caused by acids; heat-resistant to 500 degrees Fahr.; flexibility, low; tensile strength, 500-700 lb. per sq. in.; produced in color; shatterproof; specific gravity, 1.2; opaque; ages better than rubber; used for insulation.

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VYCOR—Corning Glass Works, Corning, N. Y. Glass is approximately 96 per cent pure silica; in sheets, rods or tubes, cast, molded or machined. Has high heat resistance, very low coefficient of thermal expansion, excellent corrosion resistance (except HF) and dielectric properties. Can be used at much higher temperatures than other glasses; also adaptable to high-frequency insulation. Linear coefficient of expansion .0000005 per degree Fahr.; softening point 2730 degrees Fahr.; maximum operating temperature, 1450-1750 degrees Fahr.; tensile strength, 4000-10,000 lb. per sq. in.; compressive strength, 50-200,000 lb. per sq. in.; specific gravity, 2.2; hardness, 5.5-6.5 (Moh's). Available in opaque, transparent and ultraviolet transmitting types. For rotating seal rings, thermocouple sleeves and coil forms.

W

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WELDWOOD—United States Plywood Corp., New York. Phenol-formaldehyde and urea-formaldehyde resin-bonded plywood; thermosetting; flexibility varies with thickness; splitproof; shatterproof; high tensile and dielectric strength. Obtainable in waterproof and water-resistant grades in all woods.

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WEST FELT—Western Felt Works, Chicago. Felt material; furnished in cut shapes according to user's specifications for vibration dampening, deadening sound, insulating against heat and cold and filtering liquids, air and gases; also furnished as oil or dust seals for bearings.

See advertisement, Pages 237, 246

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WESTFELTOPAK—Western Felt Works, Chicago. Gasketing material made of high grade resilient felt, coated all sides with synthetic rubber, resistant to many mineral oils, gasoline, petroleum hydrocarbons, chlorinated solvents, alcohols and dilute acids and alkalis. Recommended maximum temperature 175 degrees Fahr.

See advertisement, Pages 236, 247

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WILMINGTON FIBRE—Wilmington Fibre Specialty Co., Wilmington, Del. Cotton rag and paper, chemically treated, nonplastic material; furnished in sheet form or rods and tubes for machining or stamping into parts; dielectric strength, 200-400 volts per mil; tensile strength, 12-15,000 lb. per sq. in.; resistant to shock and corrosion; high polish; available in colors. Used for electrical and mechanical insulation.

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WOODEX—Neveroil Bearing Co., Wakefield, Mass. Impregnated rock maple furnished in parts which can be machined; heat resistant to 100 degrees Fahr.; inflammable; can be highly polished; for bearing surfaces in textile, road building, agricultural, tobacco and many other types machinery.

Index of Plastics and Nonmetallics by Type

SUPPLEMENTING the alphabetical listing by tradenames which will be found commencing on Page 188, this index has been compiled to aid the designer in the selection of nonmetallic materials where either the tradenames are not known or it is desired to compare the properties of similar materials. Such properties are given in the alphabetical listing mentioned above.

Types of materials are indexed alphabetically below, each type carrying its grouping of tradenames. In the case of plastics, two major headings, "thermosetting" and "thermoplastic", are further qualified by breakdown into chemical-base groups.

ADHESIVES
Amberlite
Tego
Uformite

ASBESTOS
Victor (sheets)

CERAMICS
Ceraware
Colonial
Firecrete
Hemit
Lenoxite
Mycalex
Steatite
U. S. Standard
Universal porcelain

COMPOSITIONS
Aertite
Armstrong
Carbocell
Celite
Centraline
Eel-slip
Farlite
Featherweight
Graphicell
Hy-temp
Illinois
Insulkote
Graphitar
Karbate
National Carbon
National Switch
Panelyte
Pinco
Plastikflex
Plastrox "B"
Plax Polyflex
Reanite
Revolite
Ryertex
Styraloy
Transflex
Victopac
Victorite
Vitric-10

CORKS
Armstrong
Vibracork
Victor

FELTS
American
Booth
Dufelt
Felters
Gaskofelt
"K" felt
Resistofelt
Unisorb
Westfelt
Westfeltopak

FIBERS
Diamond
Fyberoid
National
Peerless
Penn
Phenol
Spaulding Armite
Spaulding
Spauldo
Wilmington

GLASSES
Aerolite
Blue Ridge
Duolite
Duplate
Fiberglas
Flexseal
Herculite
LOF (heat-absorbing plate)
LOF (polished plate)
Multiplate
Polaroid
Pyrex
Thermopane
Tuf-flex
Vitrolux
Vycor

LEATHERS
Sirvis

MICA
Micabond

PLASTICS
(*Thermosetting*)

Aniline formaldehyde
Formica

Ceramic
Prestite

Fiber
Kys-ite K-100

Lignin
Lignolite
Masonite

Melamine formaldehyde
Melmac
Plaskon

Phenolic
Bakelite
Catabond
Catalin
Celoron
Co-ro-lite
Dilecto
Durez
Durite
Farlite
Formica
Indur
Indur varnish
Insurok
Lamicoid
Micarta
Ohmoid
Opalon
Phenolite
Resino
Spauldite
Structomold
Sweet Home Brand
Synthane
Taylor
Textolite
Vulcoid

Urea
Bakelite
Beetle
Insurok
Lamicoid
Plaskon
Textolite

Vinyl
Texrub

Cold molded
Ebrok
Garit
Gummon
Pyroplax
Tegit
Textolite
Thermoplax

PLASTICS
(*Thermoplastic*)

Acrylic
Crystalite
Plexiglas

Acrylic Butyrate
Gemlite

Aniline formaldehyde
Cibanite
Dilectene

Cellulose acetate
Bakelite
Cel-o-glass
Chemaco
Fibestos
Gemloid
Inceloid
Lumarith
Plastacele
Tenite
Textolite
Tulox

Cellulose ester
Anchor

Cellulose nitrate
Celanese celluloid
Nitron
Pyralin
Textolite

Ethyl cellulose
Chemaco
Ethocel

Methyl methacrylate
Lucite

Polyamide
Nylon

Polybutene
Vistanex

Polymeric
Kem-pol
Resilon
Saran

Polystyrene
Bakelite
Loalin
Plax

Polyvinyl acetal
Saflex

Polyvinyl alcohol
PVA
Resistoflex

Styrene
Lustron
Styron

Vinyl
Chemaco
Gemflex
Texrub
Tulox
Tygon
Vinylite

RUBBERS
Acadia
Ace
Ameripol
Butyl
Fel-pro Thiokol
Hyflex
Hycar
Koroseal
Lord
Luzerne
Neoprene
Perbunan
Rub-erok
Rub-tex
Sirvene
Syntoflex
Tensilastic
Thiokol
Victolene
Victoprene
Vitalic
Vulcabeston
Vulprene

VARNISHES
FS
FV
Harvel
Irvington
Irv-o-lite
Irv-o-slot
Irv-o-volt
Ivi-flex

WOODS
American
Densewood
Farlite
Haskelite
Nigrum
Pluswood
Plymetl
Plymold
Pregwood
Resnprest
Weldwood
Woodex

Producers of Plastics and Other Nonmetallics

A

American Cyanamid Co., Plastics Div., 30 Rockefeller Plaza, New York.
Urea-formaldehyde plastic—BEETLE
Melamine-formaldehyde plastic—MELMAC

American Felt Co., Glenville, Conn.
Felt material—"K" FELT and AMERICAN FELT
See advertisement, Page 240

American Hard Rubber Co., 11 Mercer St., New York.
Hard rubber—ACE

American Plywood Corp., New London, Wis.
Phenolic urea plywood—AMERICAN PLYWOOD

American Products Mfg. Co., Oleander and Dublin Sts, New Orleans.
Cellulose derivative—INCELOID

American Resinous Chemicals Corp., Peabody, Mass.
Synthetic rubber-soya material—VULPRENE

American Wringer Co. Inc., Woonsocket, R. I.
Rubber and rubber synthetics—TENSILASTIC

Am-mex Sales Co. Inc., 28 Church St., Buffalo.
Plastic-bonded plywood — SWEET HOME BRAND

Anchor Plastics Co., 71 Grand St., New York.
Cellulose ester plastics—ANCHOR Extruded Plastics

Armstrong Cork Co., Lancaster, Pa.
Cork-and-synthetic-rubber—ARMSTRONG
Resilient board of cork granules—VIBRA-CORK
See advertisement, Page 224

Atlas Powder Co., Zapon-Keratol Div., Stamford, Conn.
Cloth base and Bakelite resinous plastic—REVOLITE

B, C

Bakelite Corp., 30 E. 42nd St, New York.
Phenolic, urea, cellulose acetate and polystyrene plastics—BAKELITE

Booth Felt Co., 444—19th St., Brooklyn, N. Y.
Wool base felt—BOOTH FELT

Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.
Material for impregnated wood bushings, etc.—NIGRUM
See advertisement, Page 246

Carbide & Carbon Chemicals Corp., 30 E. 42nd St., New York.
Resinous plastic—VINYLITE

Catalin Corp., 1 Park Ave., New York.
Phenolic plastics—CATALIN, PRYSTAL and CATABOND
Styrene plastics—LOALIN

Celanese Celluloid Corp., 180 Madison Ave., New York.
Cellulose acetate plastic—LUMARITH
Cellulose nitrate plastic—CELLULOID
Cellulose acetate (transparent) sheet—LUMARITH

Central Paper Co. Inc., 2400 Lakeshore Drive, Muskegon 28, Mich.
Wood-cellulose fiber material—CENTRALINE

Chicago Rawhide Mfg. Co., 1301 Elston Ave., Chicago.
Synthetic rubber compounds—SIRVENE
Heat-resisting leather—SIRVIS

Ciba Products Corp., 77-79 River St., Hoboken, N. J.
Aniline-formaldehyde resin—CIBANITE

Colonial Insulator Co., The, Akron, O.
Ceramic material—COLONIAL CERAMICS

Colt's Patent Fire Arms Mfg. Co., 17 Van Dyke Ave., Hartford, Conn
Hard rubber and asbestos base material—VULCABESTON

Columbian Rope Co., Auburn, N. Y.
Phenolic resin base—CO-RO-LITE

Continental-Diamond Fibre Co., Newark, Del.
Phenolic plastic—DILECTO, CELORON
Resinous plastic—VULCOID
Vulcanized fibre—DIAMOND
Mica material—MICABOND
Insulating material—DILECTENE

Continental Rubber Works, 1902 Liberty St., Erie, Pa.
Mechanical rubber—VITALIC

Corning Glass Works, Corning, N. Y.
Ceramic base glasses—PYREX and VYCOR

Cutler-Hammer Inc., 12th and St. Paul, Milwaukee.
Bituminous plastic—THERMOPLAX
Asbestos base material—PYROPLAX

D, E

Densewood Corp., The, Elkhorn, Wis.
Impregnated wood—DENSEWOOD

Dow Chemical Co., Midland, Mich.
Plastic granules—ETHOCEL
Thermoplastic—STYRON and SARAN
Elastomer—STYRALOY
See advertisement, Page 155

Du Pont de Nemours, E. I, & Co. Inc., Wilmington, Del.
Chloroprene rubber—NEOPRENE
Plastic coated wire mesh—CEL-O-GLASS
Nitrocellulose base—PYRALIN
Polymethyl-methacrylate base—LUCITE
Cellulose acetate base—PLASTACELE
Polyvinyl acetate—PVA
Thermoplastic—NYLON

Durez Plastics & Chemicals Inc., North Tonawanda, N. Y.
Phenolic plastic—DUREZ

Durite Plastics Inc., 5000 Summerdale Ave., Philadelphia.
Phenol-furfural plastic—DURITE

Extruded Plastics Inc., Norwalk, Conn.
Thermoplastics—TULOX

F, G

Farley & Loetscher Mfg. Co., Dubuque, Iowa.
Phenolic and urea plastic—FARLITE
Fabric base, thermosetting plastic—FARLITE Gear Stock
Abrasive surface, phenol-formaldehyde—FARLITE Safety Treads
Wood veneers, laminated and impregnated—FARLITE COMPREG

Felt Products Co., 1504 Carroll Ave., Chicago.
Rubber strip material—FEL-PRO THIOKOL and SYNTOFLEX

Felters Co. Inc., 210 South St., Boston.
Felt for vibration, isolation, etc.—UNISORB
Felt for grease and oil retention—FELTERS FELT and DUFELT
See advertisement, Page 222

Formica Insulation Co., 4613 Spring Grove Ave., Cincinnati, O.
Laminated resinous plastic—FORMICA
Phenolic impregnated wood—PREGWOOD
See advertisement, Page 135

Garfield Mfg. Co., Garfield, N. J.
Thermosetting materials—GUMMON (black); HEMIT (gray-white); TEGIT (phenolic binder) and GARIT

Gemloid Corp., 79-10 Albion Ave., Elmhurst, L. I., N. Y.
Tubing and gasketing material—GEMFLEX
Thermoplastic material—GEMLOID
Acrylic butyrate, thermoplastic—GEMLITE

General Ceramics Co., 30 Rockefeller Plaza, New York.
Ceramic material—CERAWARE

General Ceramics & Steatite Corp., Keasbey, N. J.
Ceramic material—STEATITE

General Electric Co., 1 Plastic Ave., Pittsfield, Mass.
Nonrefractory and refractory materials—TEXTOLITE; Two types
Ceramic base—MYCALEX
See advertisement, Page 221

Goodrich, B. F., Co., Akron, O.
Thermoplastic—KOROSEAL
See advertisement, Page 228

H, I, J

Haskelite Mfg. Corp., Grand Rapids 2, Mich.
Resin-bonded plywood—HASKELITE, PLYMETL and PLYMOLD

Hycar Chemical Co., Akron, O.
Synthetic rubbers—HYCAR
See advertisement, Page 119

Illinois Electric Porcelain Co., Macomb, Ill.
Ceramic base material—ILLINOIS Chemical Porcelain

Ingersoll Plastics Co., 11 West 42nd St., New York.
Fibrous, thermosetting material—PLASTRON "B"

Irvington Varnish & Insulator Co., Irvington, N. J.
Flexible extruded plastic tubing—HYFLEX, IRV-O-LITE, IVI-FLEX and TRANSFLEX
Flexible varnished tubing—IRV-O-VOLT, RS and FV
Insulating paints, enamels—IRVINGTON
Insulating punchings—IRVINGTON
Insulating varnishes—IRVINGTON and HARVEL
Transformer lead tubing—IRVINGTON
Varnished fabrics and papers—IRVINGTON
Varnished slot insulation—IRV-O-SLOT
Plastic and varnished wire markers—IRVINGTON

Johns-Manville, 22 E. 40th St., New York.
Diatomaceous silica material—CELITE
Rubbery, asphaltic-asbestos material — AERTITE
Asbestos, fiber, graphite and rubber compound—EEL-SLIP
Weatherproof coating—INSULKOTE
Refractory material—FIRECRETE

K, L

Keasbey & Mattison Co., Ambler, Pa.
Asbestos materials—HY-TEMP and FEATHERWEIGHT

Keyes Fibre Co., Waterville, Me.
Phenolic fiber base—KYS-ITE K-100

Kopp Glass Inc., Swissvale, Pa.
Industrial glass—KGI

Lenoxite Div., Lenox Inc., 65 Prince St., Trenton, N. J.
Ceramic insulating material—LENOXITE

Libbey-Owens-Ford Glass Co., Nicholas Bldg., Toledo, O.
Figured and wire glass—BLUE RIDGE
Polished plate glass—VITROLUX, TUF-FLEX and LOF
Glass with metal edge seal—THERMOPANE
Heat-absorbing plate glass—L-O-F
See advertisement, Page 225

Lord Mfg. Co., Erie, Pa
Rubber bonding—LORD
See advertisement, Page 141

Luzerne Rubber Co., Dewey St., Trenton, N. J.
Hard rubber, thermoplastic—LUZERNE HARD RUBBER

M

Manufacturers Chemical Corp., Berkeley Heights, N. J.
Cellulose, thermoplastic—CHEMACO

Marathon Chemical Co., Div. of Marathon Paper Mills Co., Rothschild, Wis.
Lignin plastic—LIGNOLITE

Masonite Corp., 111 W. Washington St., Chicago.
(a) Exploded wood fiber—MASONITE

McDonnell Aircraft Corp., St. Louis 1.
Phenolic paper laminate—STRUCTOMOLD

Mica Insulator Co, 200 Varick St., New York.
Phenolic and urea-base plastic—LAMICOID

Miller Rubber Industrial Products Div. of The B. F. Goodrich Co., Akron, O.
Synthetic rubber—AMERIPOL

Monsanto Chemical Co., Plastics Div., Springfield, Mass.
Cellulose nitrate plastic—NITRON
Cellulose acetate—FIBESTOS
Phenolic plastic—OPALON and RESINOX
Polyvinyl acetal plastic—SAFLEX
Polystyrene, thermoplastic—LUSTRON
See advertisement, Page 227

N, O

National Carbon Co. Inc., Carbon Products Div., P. O. Box 6087, Cleveland.
Carbon or graphite in amorphous or graphitic form—NATIONAL CARBON
Porous graphite—GRAPHICELL
Porous carbon—CARBOCELL
Carbon-graphite base material—KARBATE

National Vulcanized Fibre Co., Wilmington, Del.
Laminated Bakelite—PHENOLITE
Cotton cellulose base, vulcanized fiber—NATIONAL FIBRE, NATIONAL SWITCH INSULATION
Cotton-rag base, fish-paper insulation—PEERLESS

Neveroil Bearing Co., Wakefield, Mass
Impregnated maple bearings—WOODEX

Owens-Corning Fiberglas Corp., Toledo, O.
Glass, in fiber form—FIBERGLAS

P

Panelyte Div., St. Regis Paper Co., 230 Park Ave., New York.
Laminated resinous thermosetting material—PANELYTE
See advertisement, Page 146

Penn Fibre & Specialty Co., 2030 E. Westmoreland St., Philadelphia 34.
Phenolic base material—PHENOL FIBRE
Paper base material—PENN Vulcanized Fibre

Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh.
Laminated plate glass—DUPLATE, DUOLITE, AEROLITE, MULTIPLATE, FLEXSEAL
Heat-treated Plate Glass, HERCULITE

Plaskon Division, Libbey-Owens-Ford Glass Co., 2112 Sylvan Ave., Toledo, O.
Thermosetting plastics—PLASKON

Plax Corp., 133 Walnut St., Hartford 1, Conn.
Thermoplastic materials—PLAX Polystyrene and PLAX POLYFLEX

Pluswood Inc., Oshkosh, Wis.
Resin-impregnated plywood—PLUSWOOD

Polaroid Corp., Cambridge, Mass.
Light-polarizing glass—POLAROID

The Porcelain Insulator Corp., Lima, N. Y.
Ceramic base material—PINCO Porcelain

Price Associates, M. B., 350 Fifth Ave., New York.
Rubber-like, vinyl base plastic—TEXRUB

Pylock Corp., subsidiary of M & M Wood Working Co., Portland, Ore
Phenol-formaldehyde bonded exterior plywood—RESN-PREST

R

Reilly Tar & Chemical Corp., Merchants Bank Bldg., Indianapolis.
Phenolic plastic—INDUR, INDUR VARNISH

Resinous Products & Chemical Co., 222 West Washington Sq., Philadelphia 5.
Plastic bonded plywoods—AMBERLITE, TEGO and UFORMITE

Resistoflex Corp., Belleville, N. J.
Synthetic resin base—RESISTOFLEX
See advertisement, Page 251

Richardson Co., The, Melrose Park, Ill.
Thermosetting, thermoplastic and translucent plastics—INSUROK
Hard rubber—RUB-TEX and RUB-EROK
Acid-resisting bituminous plastic—EBROK
See advertisement, Page 126

Rohm & Haas Co. Inc., 222 W. Washington Sq., Philadelphia 5.
Acrylic base plastic—PLEXIGLAS and CRYSTALITE
See advertisement, Page 125

Ryerson & Son Inc., Jos. T., 16th and Rockwell Sts., Chicago.
Bearing material—RYERTEX
See advertisement, Page 236

S, T

Sherwin-Williams Co., The, 101 Prospect Ave., N.W., Cleveland.
Vulcanizable polymer derived from vegetable oils—KEM-POL
See advertisement, Pages 138, 139

Spaulding Fibre Co. Inc., Tonawanda, N. Y.
Fibrous material — SPAULDING FIBRE, SPAULDING ARMITE and SPAULDO
Phenolic plastic—SPAULDITE

Stanco Distributors Inc., 26 Broadway, New York 4.
Nonvulcanizing Plastic—VISTANEX
Synthetic Rubbers—BUTYL and PERBUNAN

Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.
Steatite ceramic—STUPAKOFF No. 621

Synthane Corp., Oaks, Pa.
Laminated Bakelite—SYNTHANE

Taylor Fibre Co., Norristown, Pa.
Phenolic base thermosetting material—TAYLOR FIBRE

Tennessee Eastman Corp., Kingsport, Tenn.
Cellulose ester plastics—TENITE

Thiokol Corp., Trenton, N. J.
Synthetic rubber—THIOKOL

U, V, W

United States Plywood Corp., 46th St. and 12th Ave., New York.
Resin-bonded plywood—WELDWOOD

U. S. Rubber Co., 1230 Sixth Ave., New York.
Synthetic rubber—U.S.RUBBER
See advertisement, Page 133

United States Stoneware Co., Akron, O.
Chemical Stoneware—"U.S." STANDARD
Ceramic, nonplastic—VITRIC-10
Resinous thermoplastic—RESILON
Synthetic resins—TYGON
Resinous thermosetting—REANITE
See advertisement, Page 239

Universal Clay Products Co., The, Sandusky, O.
Ceramic material—UNIVERSAL PORCELAIN

Victor Mfg. & Gasket Co., 5750 Roosevelt Rd., Chicago.
Compressed sheet packing—VICTOPAC
Vegetable fiber base sheet packing—VICTORITE
Asbestos sheet—VICTOR
Cork sheet—VICTOR
Compounded synthetic rubber—VICTOPRENE
Synthetic rubber—VICTOLENE

Werner Co. Inc., R. D., 380 Second Ave., New York.
Thermoplastic, flexible tubing—PLASTIKFLEX

Western Felt Works, 4117 Ogden St., Chicago.
Felt material — WESTFELT, GASKOFELT WESTFELTOPAK and RESISTOFELT
Synthetic rubber—ACADIA
See advertisement, Pages 237, 246

Westinghouse Electric & Mfg. Co., Trafford, Pa.
Phenolic plastic—MICARTA
See advertisement, Page 115

Westinghouse Electric & Mfg. Co., Derry, Pa.
Ceramic base—PRESTITE

Wilmington Fibre Specialty Co., Wilmington, Del.
Paper base material—FYBEROID
Cotton rag and paper, nonplastic—WILMINGTON FIBRE
Phenolic plastic—OHMOID

Custom Molders of Plastics

Reference letters beneath addresses of companies refer to: (a) Types of materials utilized; and (b) Names of machine parts customarily molded.

A

Accurate Molding Corp., 116 Nassau St., Brooklyn 1.
(a) BAKELITE, DUREZ, RESINOX, BEETLE and PLASKON.
(b) Terminal blocks, electrical control boxes, terminal plates, motor replacement switches, cable connectors, instrument housing, commutators, etc.

Ackerman Plastic Molding, 986 E. 200th St., Cleveland.
(a) BAKELITE, DUREZ, BEETLE, PLASKON, TENITE, and THIOKOL.
(b) Mechanical, electrical and industrial.

Advance Molding Corp., 54 West 21st St., New York.
(a) TENITE I and II, LUCITE, cellulose acetate, and other thermoplastics
(b) All custom molded injection parts.

All American Aircraft Products Inc., 1350 E. Anaheim, Long Beach, Calif.
(a) All types of materials.
(b) Aircraft control pulleys, drums, fittings, etc.

Allied Plastics Co., 5225 Wilshire Blvd., Los
(b) To customers' specifications.
(a) Cellulose acetates, cellulose acetate butyrates, polystyrenes, methyl methacrylate, vinylidene, chloride and all other thermoplastics.
(b) Injection molded pieces, also extruded.

American Insulator Corp., New Freedom, Pa.
(a) BAKELITE, DUREZ, RESINOX, PLASKON, BEETLE, LUMARITH, TENITE, PLASTACELE, POLYSTYRENE, LUCITE, VINYLITE, ETHOCEL, and cold-molded composition.
(a) To customers' specifications.

American Molding Co., 355 Fremont St., San Francisco 5.
(a) BAKELITE, DUREZ, BEETLE, PLASKON, TENITE, LUMARITH, RESINOX, FIBESTOS, CRYSTALITE, PLASTACELE, LUCITE, POLYSTYRENE, and ETHOCEL.
(b) Technical, automotive, electrical, aircraft. etc. Compression, injection, and extrusion molded parts.

American Phenolic Corp., 1830 S. 54th Ave., Chicago 50.
(a) BAKELITE, DUREZ, AMPHENOL, SUNEX, and transparent POLYSTYRENE.
(b) Electrical small sections, special rods and tubes, electrical connectors, etc., for aircraft and radio.

American Plastics Corp., 225 W. 34th St., New York.
(a) TENITE, FIBESTOS, LUMARITH, PLASTACELE, LUCITE, etc.

(b) Extruded shapes, ribbons, tubes, rods, etc.

American Products Mfg. Co., Oleander cor. Dublin Sts., New Orleans 18.

(a) Cellulose acetates, ethyl cellulose, and aceto-butyrates.

(b) Cover shields.

Amos Molded Plastics Div., Amos-Thompson Corp., Edinburg, Ind.

(a) SARAN, ETHOCEL Acetate, TENITE II, POLYSTYRENE, LUCITE, and CRYSTALITE.

(b) Nozzles, couplings, handles, knobs, push-button lenses, etc.

Armstrong Cork Co., Industrial Div., Lancaster, Pa.

(a) Cork compositions, cork-and-synthetic-rubber compositions, synthetic rubbers, cork-and-rubber compositions, rag felt papers, fibrated leather, and other fiber sheet packing materials.

(b) Gaskets, oil-retaining rings, washers, valve disks, friction wheels, strips, blocks, disks, ribbons, polishing wheels, handles, roll coverings, packings, seals, feed rolls, friction grips, bushings, diaphragms, antiskid parts, glazing strip, vibration-damping pads, etc.

See advertisement, Page 224

Atlantic Plastics, 2730 Grand Ave., Cleveland.

(a) BAKELITE, BEETLE, PLASKON, DUREZ, RESINOX, TENITE, LUCITE, PLASTACELE, LUMARITH, THIOKOL and other synthetics.

(b) Safety supply parts, lighting and electrical, radio, chemical, mechanical, etc.

Auburn Button Works Inc., Auburn, N. Y.

(a) BAKELITE, DUREZ, RESINOX, BEETLE, PLASKON, TENITE and LUCITE.

(b) All types of machine parts.

B

Bachmann Bros. Inc., 1420-38 East Erie Ave., Philadelphia.

(a) All thermoplastics except SARAN.

(b) Radio, medical parts, etc.

Berkander Inc., George F., 891 Broad St., Providence, R. I.

(a) TENITE, LUMARITH and PLASTACELE

(b) To customers' specifications

Boonton Molding Co., 326 Myrtle Ave., Boonton, N. J.

(a) BAKELITE, DUREZ, RESINOX, TENITE, PLASTACELE, LUCITE, CRYSTALITE, STYRON, POLYSTYRENE, PLASKON and BEETLE.

(b) To customers' specifications.

Breyer Molding Co., 24 N. Racine Ave., Chicago.

(a) DUREZ, PLASKON, BAKELITE and MONSANTO.

(b) All phenolic machine parts, sockets, plugs, etc.

C

California Plastic Moulding Co., 1702 East 61st St., Los Angeles 1.

(a) BAKELITE, PLASKON, BEETLE, DUREZ, MONSANTO, etc., all thermosetting materials.

(b) Plastic aircraft and industrial parts

Cardinal Corp., 601 W. Eichel, Evansville, Ind.

(a) TENITE, LUMARITH, PLASTACELE, ETHOCEL, LUCITE, CRYSTALITE, POLYSTYRENE and other thermoplastics.

(b) Nameplates and parts made to customers' specifications.

Central Die Casting & Mfg. Co. Inc., 2935 W. 47th St., Chicago.

(a) TENITE, LUMARITH, and all other thermoplastics.

(b) All types of molded parts to 8 oz. in weight.

Chamberlain Engineering Ltd., Akron, O.

(a) All molding materials.

(b) To customers' specifications

Chicago Die Mold Mfg. Co., 1735 W. Diversey Parkway, Chicago.

(a) TENITE, BAKELITE, PLASKON, LUCITE, STYRON, etc.

(b) To customers' specifications.

Chicago Molded Products Corp., 1028 N. Kolmar Ave., Chicago.

(a) BAKELITE, DUREZ, RESINOX, PLASKON, BEETLE, TENITE, LUMARITH, SARAN, LUCITE and POLYSTYRENE.

(b) Automotive, aviation, industrial, electrical, mechanical, scientific, surgical, electrical and other parts molded to special order.

See advertisement, Page 128

Cincinnati Advertising Products Co., Plastics Div., 3274 Beekman St., Cincinnati 23.

(a) PLASTACELE, TENITE, LUMARITH, LUCITE, CRYSTALLITE, LUSTRON, POLYSTYRENE and VINYLITE.

(b) All types of injection molded machine parts

Cincinnati Molding Co., 2037 Florence Ave., Cincinnati.

(a) BAKELITE, RESINOX, DUREZ, PLASKON, BEETLE or any thermosetting plastic.

(b) Electrical, mechanical or decorative parts.

Cleveland Plastics Inc., 1611 E. 21st St., Cleveland 14.

(a) BAKELITE, BEETLE, CRYSTALITE, DUREZ, ETHOCEL, LUCITE, LUMARITH, MONSANTO, PLASKON, PLASTACELE, RESINOX, STYRON and TENITE.

(b) To customers' specifications.

Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.

(a) All plastic materials.

(b) All types of machine parts.

Columbus Plastic Products Inc., 519 Dublin Ave., Columbus, O

(a) TENITE, LUMARITH, PLASTACELE, POLYSTYRENE, LUCITE, CRYSTALITE and VINYLITE.

(b) All types of injection molded parts to customers' specifications.

Connecticut Hard Rubber Co., 407 East St., New Haven, Conn.

(a) Synthetic rubbers, all types; hard rubber.

(b) Seals, gaskets, electrical insulation parts, etc.

Connecticut Plastic Products Co., 70 W. Liberty St., Waterbury, Conn.

(a) TENITE, LUMARITH, PLASTACELE, BAKELITE-Acetate, LUCITE, POLYSTYRENE, CRYSTALITE, and other thermoplastic materials.

(b) Business machine parts, camera cases, etc.

Consolidated Molded Products Corp., 309-29 Cherry St., Scranton 2, Pa.

(a) All types of molding material for compression, transfer and injection molding.

(b) Various machine parts.

Continental Diamond Fibre Co., Newark, Del.

(a) CELORON, DILECTO, DIAMOND FIBRE, VULCOID, DILECTENE, MICABOND, etc.

(b) Gears, couplings, aircraft parts, electrical insulating parts, mechanical and chemical resistant parts.

Cutler-Hammer Inc., 315 N. 12th St., Milwaukee.

(a) THERMOPLAX and FYROPLAX.

(b) Terminal blocks, insulators, switch bases, knobs, handles, insulating bushings, arc shields and miscellaneous electrical insulating forms.

D

Davies Molding Co., Harry, 1428 N. Wells St., Chicago.

(a) Phenol-formaldehyde and synthetic ureas.

(b) General machine parts

Diemolding Corp., Canastota, N. Y.

(a) BAKELITE, DUREZ, PLASKON, BEETLE, TENITE or any other plastics of similar nature.

(b) Control handles or knobs, small bases and plates, pulleys, pushbuttons, housings, etc.

Dimco Plastics, 207 East Sixth St., Dayton 2, O.

(a) BAKELITE, DUREZ, PLASKON, TENITE, MELMAC, PLASTACELE, NIXONITE, POLYSTYRENE, VINYLITE, LUCITE, MASURON, and similar plastic materials.

(b) Aircraft control parts, bomb release handles, solenoid coil spools, handles for machine tools, electrical parts, etc.

E

Eclipse Moulded Products Co., Milwaukee.

(a) All plastic materials.

(b) Compression, injection and extrusion molded parts.

Erie Resistor Corp., 644 W. 12th St., Erie, Pa.

(a) All extrusion, jet and injection molding materials.

(b) Aircraft, automobile, radio, refrigerator parts, three-dimensional knobs, bezels, etc.; also plastic molded around glass for instrument faces.

Extruded Plastics Inc., New Canaan Ave., Norwalk, Conn.

(a) Cellulose acetate butyrate (TENITE II), vinylidene chloride (SARAN), vinyl resins and ethyl cellulose.

(b) Seamless plastic tubing from ⅛-in. to 2 in. outside diameter for oil lines, air lines, etc.

F

Firestone Rubber & Latex Products Co., Fall River, Mass.

(a) All compression and injection molding materials.

(b) Lenses, plastics over metal, refrigerator trim, cabinets and housings, electrical parts, etc.

Franklin Plastics Div., Robinson Industries Inc., Franklin, Pa.

(a) Thermoplastic materials.

(b) Automotive, refrigerator, radio, etc.

G

Garfield Mfg. Co., Garfield, N. J.

(a) BAKELITE, DUREZ, HEMIT, GARIT and TEGIT.

(b) Hot and cold molded parts to customers' specifications.

Gemloid Corp., 7910-30 Albion Ave., Elmhurst, L. I., N. Y.

(a) PLEXIGLAS, LUCITE, TENITE I and II, PLASTACELE, STYRENE, SARAN, ETHOCEL, VINYLITE, etc.

(b) Gaskets, flexible and clear tubings, dials, knobs, etc.

General Electric Co., Plastics Divisions, 1 Plastics Ave., Pittsfield, Mass.

(a) TEXTOLITE (molded, laminated and cold-molded).

(b) All types to customers' requirements.

See advertisement, Page 221

General Industries Co., Elyria, O.

(a) BAKELITE, DUREZ, RESINOX, PLASKON, BEETLE, TENITE, LUMARITH, PLASTACELE, LUCITE and CRYSTALITE.

(b) Special parts to customers' specifications.

Gits Molding Corp., 4600 W. Huron St., Chicago.

(a) TENITE, LUMARITH, PLASTACELE, LUCITE, POLYSTYRENE, SARAN, VINYLITE, butyrates and ethyl cellulose.

(b) Radio knobs and cabinets, push-buttons, escutcheons, dials, supports and insulators.

See advertisement, Page 244

Great American Plastics Co., 180 Pond St., Leominster, Mass.

(a) Thermoplastics and thermosetting materials.

(b) Parts made of sheets, rods and tubes, and special shapes by injection, compression, transfer, hollow molding, forming and extruding.

Grigoliet Co., 740 E. North St., Decatur, Ill.

(a) BAKELITE, DUREZ, INDUR, PLASKON, TENITE and BEETLE.

(b) Molded closures, knobs, handles and injection molded parts.

Gulliksen Mfg. Co., Wm. M., Newton Lower Falls, Mass.
(a) BAKELITE, MAKALOT, PLASKON, BEETLE and DUREZ.
(b) Dies and molds to produce various shapes.

I, K

Illini Molded Plastics, 528 W. Chestnut, Hinsdale, Ill.
(a) BAKELITE, DUREZ, PLASKON, MONSANTO, LUCITE, and POLYSTYRENE.
(b) Aircraft fairleads, grommets, connectors, adapters, bobbins and other electrical insulating components, water and steam valves, and foot valves for food industry.

Imperial Molded Products Corp., 2927 W. Harrison St., Chicago.
(a) BAKELITE, RESINOX, DUREZ, MAKALOT, PLASKON and BEETLE.
(b) Handles, knobs, controls, sub-assembly for mechanical working parts such as terminal blocks, insulators, contact blocks, housings, etc.
See advertisement, Page 231

Injection Molding Corp., 115 Fourth Ave., New York.
(a) TENITE, LUCITE, LUMARITH, LUSTRON, STYRENE, PLASTACELE, etc.
(b) To customers' specifications.

Insel Co., Schuyler Ave. ft. Quincy, Arlington, N. Y.
(a) All thermoplastic materials, cellulose nitrate, cellulose acetate, cellulose aceto-butyrate, ethyl cellulose and VINYLITE.
(b) Bushings, lenses, insulating tubing (flexible and rigid), etc.

Insulation Mfg. Co. Inc., 11 New York Ave., Brooklyn 16.
(a) BAKELITE, DUREZ, MAKALOT, RESINOX, LUCITE, CRYSTALITE, TENITE, LUMARITH, ELECTROSE, INSULATE, etc.
(b) Insulators and insulating parts, molded instrument and industrial parts.

Insulation Products Co., 504 North Richland St., Pittsburgh.
(a) BAKELITE, DUREZ, TENITE, PLASKON.
(b) Parts to customers' specifications.

Kampa Mfg. Co., 12132 W. Capitol Drive, Milwaukee.
(a) TENITE, STYRON, LUCITE, ETHYLCELLULOSE, LUMARITH and SARAN.
(b) Switch boxes, insulators and instrument case covers.

Keolyn Plastics Co., 2731 N. Pulaski Rd., Chicago.
(a) TENITE, LUMARITH, PLASTACELE, LUCITE, POLYSTYRENE, VINYLITE and other thermoplastics.
(b) To customers' specifications.

Keystone Specialty Co., 1373½ Cove Ave., Lakewood, O.
(a) Any plastic material to customers' specifications.
(b) Parts to customers' specifications.

Kilgore Mfg. Co., Plastics Div., Westerville, Ohio
(a) Injection molding of TENITE, LUMARITH, polystyrenes and butyrates.
(b) Parts for autos, radios, etc.

Kuhn & Jacob Molding & Tool Co., 1200 Southard St., Trenton, N. J.
(a) BAKELITE, DUREZ, BEETLE, PLASKON, TENITE, LUCITE, LUMARITH, etc.
(b) Compression molding of electrical, automotive, radio, airplane, instrument, permanent wave machine parts, etc.; also any type of injection molding.

Kurz-Kasch Inc., 1421 S. Broadway, Dayton, O.
(a) BAKELITE, DUREZ, BEETLE, PLASKON, LUMARITH, TENITE, CRYSTALITE, LUCITE, MELMAC and RESINOX.
(b) Instrument knobs, general insulating parts, both mechanical and electrical.

M

Mack Molding Co. Inc., Ryerson Ave., Wayne, N. J.
(a) BAKELITE, DUREZ, TENITE, BEETLE, LUMARITH, FIBESTOS and PLASKON.
(b) Parts to customers' specifications.

Martindell Molding Co., N. Olden at Sixth, Trenton, N. J.
(a) Cellulose acetate, phenolics and urea.
(b) To customers' specifications.

Metal Specialty Co., 814 South L St., Richmond, Ind.
(a) ETHOCEL, TENITE, CRYSTALITE, LUCITE, POLYSTYRENE, LUMARITH, NIXONITE, etc.
(b) Automobile, radio and refrigerator parts.

Michigan Molded Plastics Inc., G and Baker Sts., Dexter, Mich.
(a) BAKELITE, DUREZ, TENITE, PLASTACELE, LUMARITH, PLASKON, LUCITE, SARAN and MONSANTO.
(b) Molded plastic parts, all types and sizes by compression, injection and extrusion.

Midwest Molding & Mfg. Co., 337 N. Whipple St., Chicago.
(a) BAKELITE, DUREZ, RESINOX, BEETLE and PLASKON.
(b) Terminal blocks, electrical parts, etc.

Mills Corp., Elmer E., 812 W. Van Buren St., Chicago.
(a) Thermoplastic materials including cellulose acetate, cellulose acetate butyrate, acrylates, methacrylates, styrenes, vinyls, vinylidene chloride, etc.
(b) Injection molding and extruding of machine parts.

Minnesota Plastics Corp., 388 Wacouta St., St. Paul, Minn.
(a) TENITE II, LUMARITH, PLASTACELE, FIBESTOS, LUSTRON, POLYSTYRENE, STYRON, VINYLITE, LUCITE and PLEXIGLAS.
(b) Cream separator parts, milking machine parts, mechanical refrigerator parts, machine tool parts, etc.

Molded Products Co., 4533 W. Harrison St., Chicago.
(a) BAKELITE, DUREZ, RESINOX, MAKALOT, INDUR, PLASKON, BEETLE and MELMAC.
(b) To customers' specifications.

Molding Corp. of America Inc., 40 Church St., Pawtucket, R. I.
(a) All types of plastics.
(b) To customers' specifications.

N, O

National Plastics Inc., 2330 McCalla Ave., Knoxville 2.
(a) Thermosetting and thermoplastic compounds.
(b) Handwheels (lathes, etc.), textile machine parts, etc.

National Plastic Products Co., 100 McPhail St., Baltimore, Md. (Branch at Odenton, Md.)
(a) TENITE I and II, ETHOCEL, POLYSTYRENE and SARAN.
(b) T-shapes, moldings, rods (any shape within a 2-inch circle in continuous lengths).

Northern Industrial Chemical Co., 7 Elkins St., South Boston, Mass.
(a) BAKELITE, DUREZ, BEETLE, PLASKON, TENITE, LUMARITH, etc.
(b) Any molded part to customers' specifications.

Northwest Plastics Inc., 2233 University Ave., St. Paul, Minn.
(a) BAKELITE, INDUR, DUREZ, MAKALOT, LUCITE, RESINOX, BEETLE, and PLASKON.
(b) Industrial parts of all types.

Norton Laboratories Inc., 520 Mill St., Lockport, N. Y.
(a) BAKELITE, DUREZ, PLASKON, BEETLE, TENITE, LUMARITH, LUCITE, CRYSTALITE and PLASTACELE.
(b) Housings, terminals, bushings, wheels, knobs, handles, etc.

Oris Mfg. Co. Inc., 1 Jackson St., Thomaston, Conn.
(a) BAKELITE, DUREZ, RESINOX, BEETLE and PLASKON.
(b) Handwheels, bushings, etc.

Owens-Illinois Glass Co., Toledo, O.
(a) DUREZ, BAKELITE, RESINOX, PLASKON UREA, MELAMINE, BEETLE, LUMARITH, TENITE I and II, POLYSTYRENE, SARAN and ETHOCEL.
(b) Sixteen different aircraft machine parts, water pump valve seats, followers, packing nuts, electric motor brush-holder screws, line connectors, etc.

P

Paragon Molded Plastics Inc., 306 Maritime Bldg., 911 Western, Seattle, Wash.
(a) PLASKON, BEETLE, BAKELITE UREA, MELMAC, PLASKON, MELAMINE, DUREZ, RESINOX, POLYSTYRENE, VINYL and cellulose acetates.
(b) Valve handles, balls and check, control knobs, electrical switches, etc.

Peerless Molded Plastics Inc., 401 Hamilton St., Toledo, O.
(a) DUREZ, RESINOX, BAKELITE, TENITE, LUMARITH, LUCITE, and PLEXIGLAS.
(b) Electrical, mechanical, radio, automotive, camera, etc.

Pierce Plastics Inc., 116 First St., Bay City, Mich.
(a) TENITE, SARAN, LUSTRON, VINYLITE, LUMARITH, PLASTACELE, ETHOCEL, CRYSTALITE, LUCITE, and KOROSEAL.
(b) Electrical, trim, etc.

Pittsburgh Plastics Co., 1304 Fifth Ave., New Kensington, Pa.
(a) BAKELITE, DUREZ, PLASKON, and other thermosetting materials.
(b) Air corps and ordnance parts, etc.

Plastex Corp., The, 402 Mt. Vernon Ave., Columbus, O.
(a) All types of thermosetting and thermoplastic materials.
(b) Any fabrication or extrusion to customers' specifications.

Plastics Inc., 813 Main St., Avon, N. J.
(a) BAKELITE, TENITE, LUCITE, LUMARITH and PLASTACELE.
(b) Refrigerator, automotive, etc.

Plastics Inc., 20 East Chicago Ave., St. Paul, Minn.
(a) BAKELITE, BEETLE, PLASKON, INDUR, NEOPRENE and HYCAR.
(b) Terminal blocks, bushings and other machine parts.

Plastic Industries Inc., 160 Northfield Rd., Bedford, O.
(a) Phenolics or thermosetting materials.
(b) Various machine parts.

Plastic Molding Corp., Sandy Hook, Conn.
(a) BAKELITE, DUREZ, RESINOX, MAKALOT, BEETLE, PLASKON, RESIN-X-CREPE, LUCITE, FIBESTOS, LUMARITH, TENITE I, etc.
(b) Insulators, wiring devices, bases, housings, connectors, etc.

Plastimold Inc., 61 Union St., Attleboro, Mass.
(a) TENITE, BAKELITE, DUREZ, RESINOX, MAKALOT, BEETLE, PLASKON.
(b) Specialize in large housings, etc., compression molding.

Precision Plastics Co., 1724 W. Indiana Ave., Philadelphia.
(a) TENITE I and II, LUMARITH, FIBESTOS, PLASTACELE, LUSTRON, LOALIN, LUCITE, CRYSTALITE, ETHOCEL, VINYLITE and POLYSTYRENE.
(b) Radio accessories, instrument parts, etc.

Pyro Plastics Co., The, 526-532 North Ave. East, Westfield, N. J.
(a) TENITE, PLASTACELE, LUMARITH, FIBESTOS, POLYSTYRENE, LUCITE and CRYSTALITE.
(b) To customers' specifications.

R

Rathbun Molding Corp., 290 Rochester St., Salamanca, N. Y.
(a) PLASKON, BEETLE, BAKELITE, DUREZ, MELMAC, RESINOX, DURITE and MAKALOT.

(b) Electrical parts, instrument parts, knobs and handles.

Recto Molded Products Inc., Appleton & B. & O. RR., Cincinnati.

(a) BAKELITE, DUREZ, RESINOX, PLASKON, TENITE, LUCITE, CRYSTALITE and MAKALOT.

(b) Control balls (all sizes), handwheels.

Remler Co. Ltd., 2101 Bryant Ave., San Francisco.

(a) BAKELITE, DUREZ, PLASKON, TENITE, etc.

(b) Electric terminals and switch parts, housings, handles, levers, operating keys and buttons, gears, etc.

Reynolds Molded Plastics Div., Reynolds Spring Co., Cambridge, O.

(a) BAKELITE, PLASKON, TENITE, LUMARITH, DUREZ, LUCITE, RESINOX and POLYSTYRENE.

(b) All types to customers' specifications by compression, injection and extrusion molding.

Richardson Co., The, 27th and Lake Sts., Melrose Park, Ill.

(a) INSUROK, EBROK, RUB-TEX and RUBEROK.

(b) All types to customers' specifications.

See advertisement, Page 126

Royal Moulding Co., 69 Gordon Ave., Providence, R. I.

(a) BAKELITE, RESINOX, DUREZ, PLASKON, BEETLE, MAKALOT.

(b) Electrical appliance housings.

S

Shaw Insulator Co., 150 Coit St., Irvington, N. J.

(a) All plastic materials.

(b) All types of parts.

Sheller Mfg. Corp., Portland, Ind.

(a) SHELLERITE, all types of thermosetting, thermoplastic and rubber materials.

(b) Compression and injection molded parts such as steering wheels, panels, cabinets, etc.

Sinko Tool & Mfg. Co., 351 North Crawford Ave., Chicago.

(a) Ethyl cellulose, cellulose acetate, cellulose acetate butyrate, polystyrene, methacrylates, etc.

(b) Radio, electrical, automotive, etc.

Southern Plastics Co., 906-908 Main St., Columbia, S. C.

(a) TENITE I and II, BAKELITE, LUMARITH, PLASTACELE and practically all thermoplastics and thermosetting plastics.

(b) Cotton loom sheaves, tubing, bearings, nameplates, strips, links, etc.

Specialty Insulation Mfg. Co. Inc., Hoosick Falls, N. Y.

(a) COLASTA, BAKELITE, DUREZ, TENITE, BEETLE, PLASKON, etc.

(b) Business machine parts, etc.

Standard Plastics Co., 62 Water St., Attleboro, Mass.

(a) Methyl-methacrylate, cellulose acetate, polystyrene and various thermosetting materials.

(b) All types of injection and compression molded parts.

Standard Products Co., 505 Boulevard Bldg., Detroit.

(a) BAKELITE, RESINOX, DUREZ and other thermosetting materials; TENITE, LUMARITH, POLYSTYRENE, ETHOCEL, LUCITE and other thermoplastics.

(b) Automotive, refrigeration panels and accessories, radio cabinets, electrical appliance parts, aircraft parts, etc.

Sterling Plastics Co., 1140 Commerce Ave., Union, N. J.

(a) LUCITE, TENITE, LUMARITH, POLYSTYRENE, and CRYSTALITE.

(b) Knobs, cigarette vending machine parts, nameplates, dehydrator tubes and dials for aircraft, compasses, etc.

Sterling Injection Molding Inc., 277 Military Rd., Buffalo.

(a) LUMARITH, FIBESTOS, TENITE I and II, ETHOCEL, PLASTACELE, VINYLITE, SARAN, LUCITE, PLEXIGLAS, POLYSTYRENE and other thermoplastics.

(b) Handles, rollers and other injection molded machine parts.

Stokes Rubber Co., Jos., Taylor and Webster Sts., Trenton, N. J. (Plant also at Welland, Ont., Canada)

(a) All types of thermosetting and thermoplastic materials, and hard rubber.

(b) Parts made by compression or injection molding.

Synthetic Moulded Products Inc., Wakefield, R. I.

(a) All urea and phenolic materials.

(b) Automotive, marine, aircraft, and industrial machine parts.

T

Tech-Art Plastics Co., 41-01 36th Ave., Long Island City, N. Y.

(a) All plastic materials.

(b) Compression and injection molded parts for electrical equipment and instruments.

Telex Products Co., Telex Park, Minneapolis.

(a) Compression materials, BAKELITE, BEETLE, etc.

(b) Transmitter cases, control knobs, cord connectors, receiver caps, control housings, etc.

Terkelsen Machine Co., 326 A St., Boston.

(a) DUREZ, INDUR, MAKALOT, BAKELITE, PLASKON and BEETLE.

(b) To customers' specifications.

Ther Electric & Machine Works, 17 S. Jefferson St., Chicago.

(a) DUREZ, BAKELITE, PLASKON, etc.

(b) To customers' specifications.

Tupper Plastics, Farnumsville, Mass.

(a) TENITE I and II, LUMARITH, PLASTACELE, FIBESTOS, MACITE, BAKELITE, NIXON and other thermoplastics.

(b) Lenses, washers, molded screws, studs, knobs, handles, socket plugs, etc.

U

United Plastics Corp., 3828 East 91st St., Cleveland.

(a) Thermosetting materials, DUREZ, BAKELITE, etc.

(b) Small functional parts not over 7 oz.

United States Stoneware Co., Akron, O.

(a) Compression molding and extruding of TYGON synthetic resins.

(b) To customers' specifications.

See advertisement, Page 239

Universal Plastics Corp., 235 Jersey Ave., New Brunswick, N. J.

(a) All materials which can be compression and injection molded.

(b) To customers' specification.

V

Van Norman Molding Co., 6441 S. State St., Chicago.

(a) BAKELITE, DUREZ, DURITE, MONSANTO, PLASKON, BEETLE and other thermosetting materials.

(b) Electrical meter cases and bases, connectors, etc.

Victor Metal Products Corp., 196 Diamond St., Brooklyn.

(a) BAKELITE, PLASKON, RESINOX, POLYSTYRENE and TENITE.

(b) Parts requiring high impact material, such as rollers, wheels, etc.

W

Ward Plastic & Rubber Co., 700 Woodward Ave., Rochester, Mich.

(a) All thermoplastic and thermosetting materials.

(b) To customers' specifications.

Warren Plastics Corp., Warren, Pa.

(a) BAKELITE, DUREZ, RESINOX, BEETLE, PLASKON and MASURON.

(b) Small machine parts.

Waterbury Button Co., The, 39 River St., Waterbury, Conn.

(a) BAKELITE, DUREZ, BEETLE, PLASKON, TENITE, LUCITE, SHELLAC COMPOSITION, LUMARITH, RESINOX, CRYSTALITE, POLYSTYRENE, etc.

(b) All types to customers' specifications.

Watertown Mfg. Co., 138 Echo Lake Rd., Watertown, Conn.

(a) NEILLITE, BAKELITE, DUREZ, RESINOX, TENITE, LUMARITH, FIBESTOS, PLASTACELE, LUCITE, BEETLE and PLASKON.

(b) Contact blocks, insulator blocks, switch housings, cams, spacers, radio cabinets, cases and any other moldable parts.

Werner Co. Inc., R. D., 380 Second Ave., New York.

(a) Cellulose acetate, cellulose acetate butyrate, ethyl cellulose, polystyrene, and the vinyl resins.

(b) Trim, hose, gaskets, angles, channels, special shapes, rods and tubes, etc.

White Dental Mfg. Co., The S. S., Plastics Dept., 10 E. 40th St., New York.

(a) TENITE, LUMARITH, LUCITE, CRYSTALITE and POLYSTYRENE.

(b) Automotive, aircraft, electrical, etc.

Windman Brothers, 3325 Union Pacific Ave., Los Angeles.

(a) BAKELITE, DUREZ, PLASKON, BEETLE, all phenolics and ureas; styrenes, acrylic resins and TENITE or cellulose acetates.

(b) Electric razor cases, radio cabinets, electrical, mechanical, dental, photographic and surgical equipment parts.

Stampings Producers

Reference letters beneath addresses of companies refer to: (a) Types, materials and sizes of stampings; (b) Names of stamped machine parts customarily produced: and (c) Machining, heat-treating or assembling facilities.

A

Accurate Spring Mfg. Co., 3811 W. Lake St., Chicago.
(a) Blanking, forming and perforating all metals, small and medium sizes, specializing in spring materials.
(b) To customers' specifications.
(c) Complete facilities.

Ace Mfg. Corp., 1201 E. Erie Ave., Philadelphia.
(a) Blanking, forming and extruding, in pieces 8-12 inches in size, to 75-ton pressure and 2 inches depth of draw.
(b) To customers' specifications.
(c) Complete facilities.

American Stamping Co., Battle Creek, Mich.
(a) Flat, drawn and formed stampings in all metals, small and medium. Extra deep drawing a specialty.
(b) Grease cups, oil cups, and automotive, radio and aircraft parts.
(c) Complete facilities.

Advance Stamping Co., 7075 Lyndon Ave., Detroit.
(a) Terminals, small drawn shells in steel, carbon and stainless steel, brass, copper, aluminum and monel metals; shells $\frac{1}{16}$-1½ dia. Largest blank 16 gage, 2½ dia.
(b) Small parts for electrical equipment, etc.
(c) None.

Aluminum Goods Mfg. Co., Washington St., Manitowoc, Wis.
(a) Stampings, spinnings and deep drawings in aluminum, stainless steel and other metals.
(b) Refrigerator, radio, textile, electrical, airplane and automotive parts.
(c) Complete facilities.

American Emblem Co. Inc., Box D 116, Utica, N. Y.
(a) Art metal and intricate stampings up to 16 in. square; .003 to .25-in. metal thickness.
(b) Embossed nameplates, radio escutcheons and dials and ornamental trim and stampings.
(c) Complete facilities.

American Pulley Co., 4200 Wissahickon Ave., Philadelphia.
(a) Pressed steel stampings in light to heavy steel gages; also deep drawn stampings.
(b) To customers' specifications.
(c) Complete facilities.

B

Barnes-Gibson-Raymond Div., Associated Spring Corp., 6391 Miller Ave., Detroit. (The Cook Plant—Ferry Field and Boulevard drive, Ann Arbor, Mich.)
(a) Small flat springs and stampings from carbon and alloy steels and nonferrous metals.
(b) Special small stampings, formed flat wire parts, catches, clips, contacts, snap rings, retainers and washers.
(c) Complete facilities.

Basca Mfg. Co. Inc., 3019 Roosevelt Ave., Indianapolis 1.
(a) Tube forming and small flat, drawn, formed stampings of cold-rolled and hot-rolled pickled steel up to No. 12 U.S.S. Ga. steel; small and medium sized.
(b) Automotive muffler parts.
(c) Machining and assembling facilities.

Behringer Sheet Metal Works Inc., E., 108-122 Jabez St., Newark 5, N. J.
(a) Flat, drawn, formed, etc., of steel, brass, aluminum, stainless steel, to 24 x 48 inches in size. Formed sections to 20 ft. long.
(b) Miscellaneous, to customers' specifications.
(c) Complete facilities.

Bossert Co. Inc., The, 1002 Oswego St., Utica, N. Y.
(a) Stampings from .005 to 1 in. in thickness, any metal.
(b) Automotive, refrigeration, washing machine, radio, etc.
(c) Assembling and welding facilities.

Brewer-Titchener Corp., The, 111 Port Watson St., Cortland, N. Y.
(a) Flat, formed, and drawn stampings of ferrous and nonferrous, stainless, etc., up to 30 x 60 in. in size and 4 in. max. draw.
(b) To customers' specifications.
(c) Complete facilities.

Bridgeport Chain & Mfg. Co., The, Bridgeport, Conn.
(a) Small, flat stampings of steel, brass and bronze, to .065 in. gage, 4 in. length or dia.
(b) To customers' specifications.
(c) Complete facilities.

Budd, Edward G., Mfg. Co., Philadelphia, (Detroit branch located at 13141 Charlevoix Ave.)
(a) Automobile body and large and small special stampings of mild and stainless steels.
(b) Automotive, chemical and rayon, railway passenger car, commercial truck trailer, marine and aircraft parts.
(c) Complete facilities.

Buffalo Brake Beam Co., 140 Cedar St., New York.
(a) Small stampings from light bars and strip stock.
(b) To customers' specifications.
(c) Information not available.

By-Products Steel Corp., Coatesville, Pa.
(a) Flat plates pressed, bent, sheared or blanked, and flame-cut steel shapes, in gages from No. 10 to 25 in. thick.
(b) To customers' specifications.
(c) Information not available.

C

Chapin, The R. E., Mfg. Works Inc., 29 Liberty St., Batavia, N. Y.
(a) Blanks to 26-in. dia. light gage.
(b) Sprayers, atomizers, pumps, steel barrels.
(c) Machining.

Chase Brass & Copper Co. Incorporated, 236 Grand St., Waterbury 91, Conn.
(a) All types sheet metal stampings, drawn shells of brass, copper and copper alloys.
(b) All types of parts.
(c) Machining, polishing, plating and assembling facilities.

City Auto Stamping Co., Lint and Dura Ave., Toledo, O.
(a) Large light-gage stampings.
(b) Automotive.
(c) Assembling facilities.

Cleveland Steel Products Corp., Plant No. 2, Wellington, O.
(a) All types to 12 in. draw, 12 in. dia., ¼ in. thick.
(b) Automotive, industrial and electrical.
(c) Complete secondary operation, cyanide hardening, plating and assembling.

Cogswell Mfg. Co., 140 Norman St., West Springfield, Mass.
(a) Flat, drawn and formed; of steel, aluminum and brass; 4 x 12 in., to $\frac{5}{32}$-inch thick.
(b) Airplane fittings and other machine parts.
(c) Adequate secondary equipment and assembling.

Columbia Metal Stamping Co., The, 11900 Harvard Ave., Cleveland.
(a) Light and medium stampings in all metals to ¼ in. thick, to 24 x 24 in. Deep drawn to 3½ in. deep, ⅛ thick.
(b) Automotive, electrical, industrial and general.
(c) Complete facilities.

Commercial Shearing & Stamping Co., 1773 Logal St., Youngstown, O.
(a) To 60 in., ¾-in. gage, steel and copper alloys, aluminum and stainless steel.
(b) Tank heads and water heater parts.
(c) Machining and assembling facilities.

Cuyahoga Spring Co., The, 10301 Berea Rd., Cleveland.
(a) Stampings of cold-rolled steel, up to No. 10 gage; flat springs stamped or formed and tempered for mechanical purposes; also brass, bronze stampings.
(b) Primarily flat springs.
(c) Complete facilities.

D

Dahlstrom Metallic Door Co., Buffalo St., Jamestown, N. Y.
(a) Steel, stainless steel, brass, bronze, aluminum stampings and drawn parts. Press equipment Bliss 3-B to 8-E, Toledo press (bed 88 in. x 44 in.), brake presses for sections 10 to 12 ft. long.
(b) Machine guards, cabinets, latches, brackets and special parts.
(c) Assembling facilities.

Dayton Rogers Mfg. Co., 2835-12th Ave., Minneapolis.
(a) Stampings of steel, brass, copper and other sheet alloys, as well as bakelite and similar synthetics.
(b) Metal stampings in small lots for the aircraft industries including all instruments and other stamped products required in limited quantities.
(c) Pneumatic die cushions adaptable to all power presses for the sheet metal working trade.

Dellinger Mfg. Co., 725 N. Prince St., Lancaster, Pa.
(a) Flat and formed; of steel, copper, and aluminum; to fit presses up to 100-ton capacity with bottom area of 30 x 40.
(b) Electric controller parts, radio, etc.
(c) Assembling and welding facilities.

Detroit Stamping Co., 350 Midland Ave., Detroit 3.
(a) Flat, drawn to 2½ deep, formed, coined, of steel and alloys, annealed and tempered, and nonferrous metals; small and medium, to 2 x 3 ft.
(b) Pressed metal parts for all types of machines.
(c) Light machining and assembling.

Dickey-Grabler Co., 10302 Madison Ave., Cleveland.
(a) Metal stampings, 20-150 ton presses.
(b) Various machine parts.
(c) Assembling, riveting, welding.

Dunbar Brothers Co., Div. of Associated Spring Corp., Bristol, Conn.
(a) Flat and formed stampings of spring steel, stainless and other alloys in small sizes.
(b) Information not available.
(c) Heat-treating facilities.

E, F

Eaton Mfg. Co. Stamping Div., 755 E. 140th St., Cleveland.
(a) All type stampings, excepting long draws, of steel, brass and aluminum; in small and medium sizes (to 15-inch blank).
(b) Gas, oil and radiator caps and necks, etc.
(c) Trimming, facing, threading, plating, assembling.

Eureka Tool & Machine Co., 17 W. 54th St., New York.
(a) Small and medium stampings.

(b) To customers' specifications.
(c) Complete facilities.

Falstrom Co., 34 Main Ave., Passaic, N. J.
(a) Fabricated steel parts of all kinds.
(b) Machine bases, frames, guards, instrument panels, etc.
(c) Machining and assembling facilities.

Firestone Steel Products Co., Akron, O.
(a) Flat, drawn, formed, etc.; carbon and alloy steels; small, medium and large.
(b) Automotive, washing machine and conveyor parts, etc.
(c) Complete facilities.

Fox Co., Fox Bldg., Cincinnati.
(a) Metal stampings.
(b) Nameplates, escutcheons, etc.
(c) Assembling facilities.

G

Geometric Stamping Co., The, 1111 E. 200th St., Cleveland.
(a) Any type stampings in steel, stainless steel, brass, etc., ½ in. thick, 48 x 48 in.
(b) Dairy, washing machine, radio, railroad and automobile parts, etc.
(c) Complete facilities.

Geuder, Paeschke & Frey Co., 324 N. 15th St., Milwaukee.
(a) Deep drawn in all metals to 48 in. dia. 18 in. deep, 12-30 gage.
(b) Government sheet metal work.
(c) Complete facilities.

Gibson Co., William D., Div. of Associated Spring Corp., 1800 Clybourn Ave., Chicago.
(a) Miscellaneous stampings of cold-rolled spring steel, stainless and alloys, small and medium.
(b) Springs.
(c) Heat treating facilities.

Globe Machine & Stamping Co., The, 1250 W. 76th St., Cleveland.
(a) Metal stampings of all sizes.
(b) Stamping assemblies, tumbling and burnishing barrels.
(c) Machining and assembling facilities.

Goat Metal Stampings Inc., 314 Dean St., Brooklyn 17.
(a) Small, flat, drawn, formed, blanks, etc.; of stainless steel, nickel, monel, copper alloys, tin plate, aluminum, etc.; from .002 to ⅛-in. thick, generally under 2 in. wide, max. 6 x 12 in.
(b) Electronic parts.
(c) Proper facilities for light work.

Grammes, L. F., & Sons Inc., Allentown, Pa.
(a) Stampings of brass, aluminum, steel, etc.
(b) Automotive, radio, clock and electrical.
(c) Complete facilities.

Gray, Peter, Corp., 290 Third St., Cambridge, Mass.
(a) Steel and nonferrous metals, drawn, stamped and formed, up to 5/16 in. thick; 4 to 400 ton presses with bed areas up to 25 sq. ft. Power and hand brakes for 10-gage material by 8 ft. long.
(b) Handles, guards, stop motions, meters, fans, covers, radio, refrigerator casings, propeller heads, and textile machine parts.
(c) Complete assembling and finishing.

Gregory Mfg. Co., 67 Franklin St., New Haven, Conn.
(a) Flat, up to 10 in. x 10 in., formed and drawn stampings of brass, steel, copper and aluminum. Maximum depth of draw 1¼ in.; small to medium sizes—maximum blank 10 in. x 10 in.
(b) Electric knife switches, spring tension washers, etc.
(c) Complete facilities.

Griest Mfg. Co., The, New Haven, Conn.
(a) Small stampings, specializing on forming operations.
(b) Business machine, photographic, electrical, sewing machine parts and assemblies.
(c) Complete facilities.

Griffith-Hope Co., 6607 W. Mitchell St., West Allis, Wis.
(a) Formed and drawn shapes; 5 in. max. depth.
(b) All types of stampings.
(c) Welding, enameling, assembling.

Guarantee Specialty Mfg. Co., The, E. 96th St., Cleveland.
(a) Flat and drawn stampings, drawing not exceeding 4 in. deep; of sheet steel, band iron, sheet and coil brass, copper, bronze and aluminum in small and medium sizes.
(b) Washers, shims, airplane washers, etc.
(c) Heat treating, plating and finishing.

Guth Co., The Edwin F., 2615 Washington Ave., St. Louis 3.
(a) Flat (die punched), deep drawn (12-15 in. deep), and die formed (channels, etc.); of steel, brass, and aluminum; in 30-in. dia. to less than an inch in size.
(b) Switch parts, fan blades, etc.
(c) Machining and assembling.

H, I

Heyman Mfg. Co., Michihan Ave., Kenilworth, N. J.
(a) Blanked and formed stampings of strip steel, brass, copper and aluminum to 5/16 in. thick and 6 in. long.
(b) Electrical contacts and aircraft brackets
(c) None.

Hubbard, M. D., Spring Co., Pontiac, Mich.
(a) Small stampings in spring steels, hot and cold-rolled steel, brass, bronze, aluminum, Monel and stainless steel.
(b) Expansion plugs, washers, flat springs and spring washers.
(c) Drilling, tapping, spot welding, and heat treating.

Hunter Pressed Steel Co., Lansdale, Pa.
(a) All types, small and medium; max. 15 in. blank, ⅜ in. stock.
(b) All types of machine parts.
(c) Complete facilities.

Indiana Pressed Steel Co., Muncie, Ind.
(a) Medium and medium-large stampings in all metals.
(b) Refrigerator, automotive, radio, electrical, etc.
(c) Complete facilities.

K

Kickhaefer Mfg. Co., 901 S. Second St., Milwaukee.
(a) Small and medium stampings of steel, brass, copper and aluminum.
(b) Valve spring washers, special washers, tubing and wire clips, engine front and rear plates, plugs, etc.
(c) None.

Kirk & Blum Mfg. Co., The, 2850 Spring Grove Ave., Cincinnati, O.
(a) All types except heavy or deep-drawn stampings; in steel, copper, brass, aluminum, stainless and monel, to 48 in. wide max., 120 in. long max.
(b) Machine bases, pedestal, guards, lathe pans, truck body and cab parts.
(c) Assembling facilities.

Klein Mfg. Co., Burlington, Ia.
(a) Steel and galvanized iron stampings.
(b) To customers' specifications.
(c) Complete facilities.

Knott, A. J., Tool & Mfg. Corp., 6 Front St., Milford, Mass.
(a) Medium and light metal stampings; in all types, of steel, brass, phosphor bronze, aluminum and nickel-silver.
(b) To customers' specifications.
(c) Heat-treating and assembling facilities.

L

LaGanke & Sons Stamping Co., 864 E. 140th St., Cleveland.
(a) Blanked, pierced, formed, drawn, and embossed stampings of stainless steel, steel, brass, copper, aluminum and aluminum alloys, with press capacity to 70 tons.
(b) Internal and external thread protectors, stamped nuts, baffles, ferrules, etc.
(c) Assembling facilities.

Laminated Shim Co. Inc., Glenbrook, Conn.
(a) Small, flat, brass; all types of steel, zinc, copper, etc.
(b) Shims.
(c) None.

Lansing Stamping Co., Lansing, Mich.
(a) Flat, drawn and formed stampings; of steel sheets, strip and plates; small to medium
(b) To customers' specifications.
(c) Limited facilities.

Larson Tool & Stamping Co., Attleboro, Mass.
(a) All types of stampings in metals from very small to moderately heavy sizes.
(b) All types of machine parts.
(c) Machining and finishing.

Leake Stamping Co., The, 1250 East First St., Monroe, Mich.
(a) Drawn, formed, flat, steel, brass, copper and aluminum stampings in all sizes requiring up to 400-ton pressure with 20-inch stroke.
(b) To customers' specifications.
(c) Welding facilities.

Lee Spring Co. Inc., 30 Main St., Brooklyn.
(a) Flat punched and formed stampings of spring steel, stainless, brass, copper, bronze, etc., from strip material only, up to 3 in. wide.
(b) Spring washers, spring clips, etc.
(c) Heat-treating and finishing facilities.

Lewyt Metal Products Co., 60 Broadway, Brooklyn.
(a) Sheet metal stamping.
(b) Precision machine parts.
(c) Machining and assembling facilities.

Liberty Electric Co., 1915-25 Madison Ave., Indianapolis.
(a) Flat, drawn, formed, etc., also spinning to 44-in. dia.; of stainless steel and all nonferrous metals; flat and formed to 16 x 20 and shallow draws, deep drawing 10-in. dia., 8 ft. deep.
(b) To customers' specifications.
(c) Complete facilities.

Lukens Steel Co., Coatesville, Pa.
(a) Hot-rolled plates up to 195 inches wide and from 5/16 to 25 in. thick, spun and pressed steel heads and other pressed steel shapes in thicknesses from 5/16-in. to 6 in.
(b) To customers' specifications.
(c) Information not available.

Lyon Metal Products Inc., Aurora, Ill.
(a) Sheet metal stampings in wide range gages, sizes and drawing operations.
(b) Aircraft parts, also parts for ordnance, tanks, ships, etc.
(c) Heat-treating, finishing, annealing, welding.
See advertisement, Page 132

M

Metal Auto Parts Co. Inc., 1428 W. Henry St., Indianapolis.
(a) Flat, drawn, deep-drawn and formed stampings of steel and aluminum in medium and large sizes.
(b) Hoods, fenders, running boards, roofs, cowls, etc.
(c) Assembling facilities.

Milcor Steel Co., 4100 W. Burnham St., Milwaukee 4.
(a) Flat, drawn, formed and intricate stampings of all types, in hot and cold-rolled and galvanized sheets, copper, tin, etc., 16 gage to 30 gage; very small to medium large (6 sq. ft. max.).
(b) To customers' specifications.
(c) Complete machining and assembling.

Midland Steel Products Co., Cleveland (Another plant at Detroit).
(a) Flat, formed and drawn stampings of .05-.3 carbon and high tensile steels in small, medium and heavy sizes to 25 ft. long.
(b) Automotive, lathe pans, etc.
(c) Machining and assembling facilities.

Milwaukee Metal Spinning Co., 1325 S. 43rd St., Milwaukee.
(a) Aluminum, brass, copper, steel, magnesium, zinc, stainless steel, Inconel, nickel, monel, nickel-silver, silver, gold, etc.; from ⅛-in. to 8 ft. dia., depth to 40 in.; ¼-in. thick aluminum or copper; 5/16-in. thick steel, brass, hard alloys including stainless, steel, monel, Inconel.
(b) For dairy and food handling equipment, farm equipment, electric motors, unit heaters, air conditioning, aircraft, etc.
(c) Complete facilities.
See advertisement, Page 248

Morrison Products Inc., 16816 Waterloo Rd., Cleveland.
(a) All gages up to ¼ in., deep drawn stampings up to 6 in. deep, in steel and other metals.
(b) All types of machine parts.
(c) Complete assembling, spotwelding, riveting, machining and japanning facilities.

Mullins Mfg. Corp., Salem, O. (Another plant at Warren, O.)
(a) Light and heavy-gage stampings, light-

gage deep-drawn stampings from 20 to 16 gage in sizes to 80 x 160, depth of draw to 22 in.
(b) Washing machine tubs, steel evaporators and automobile parts.
(c) Assembling facilities.

Murray Corp. of America, 7700 Russell St., Detroit.
(a) Light and heavy sheet metal stampings.
(b) Auto bodies, fenders, hoods, frames, grilles and airplane parts.
(c) Assembling and finishing facilities.

N

National Formetal Co., 6539 Metta Ave., Cleveland.
(a) Formed steel, brass and bronze stampings in diameters from $\frac{5}{16}$ in. inside to 5 in. outside, lengths to 14 in.
(b) Bushings, spacers, grommets, ferrules and tubes.
(c) Welding facilities.

National Stamping Co., 6-30 St. & Jean Ave., Detroit.
(a) Flat, drawn and formed stampings of brass, steel, copper and aluminum up to $\frac{1}{4}$ in. thick material.
(b) Automotive parts, assemblies and miscellaneous pressed metal parts.
(c) Complete facilities.

New England Pressed Steel Co., Washington Ave., Natick, Mass.
(a) Stampings of steel, brass, copper, stainless steel and aluminum, small and medium.
(b) To customers' specifications.
(c) Heat-treating, finishing and assembling facilities.

New Products Corp., Benton Harbor, Mich.
(a) Flat, drawn and formed stampings of all metals; largest press capacity 125 tons.
(b) Automotive and commercial parts.
(c) Complete facilities.

Noera Mfg. Co., Div. of Chase Brass & Copper Co. Incorporated, Waterbury, Conn.
(a) Medium and light stampings of copper, brass, steel, 14 in. and smaller.
(b) Washers, oilers, etc.
(c) Assembling facilities.

Norris Stamping & Mfg. Co., 5215 S. Boyle Ave., Los Angeles.
(a) All types of sheet metal stampings and deep drawing; ferrous and nonferrous materials; sizes from very small to medium large.
(b) Subcontract stampings of all types.
(c) Complete facilities.

O, P

O. K. Machine Co. Inc., Fairfield and Poplar Aves., Fort Wayne, Ind.
(a) Stampings from smallest sizes to not exceeding 24 in. overall and not over 6 in. deep, of steel, brass, copper and aluminum.
(b) Laminations, cups, automatic photograph and radio, liquid dispensing pump parts, etc.
(c) Complete facilities.

Paul & Beekman Div., Philadelphia Lawn Mower & Mfg. Co., 18th & Courtland Sts., Philadelphia.
(a) Flat, drawn, formed and assembled stampings of steel, copper, brass, aluminum, zinc, bronze, etc.; capacity to 250 tons pressure; to 42 in. by ¼ in. thick material.
(b) Aircraft, Ordnance, Navy, etc.
(c) Complete facilities.

Philadelphia Steel & Wire Corp., Penn St. and Belfield Ave., Philadelphia.
(a) Punch press steel stampings, in all sizes suitable for presses up to 10 tons.
(b) To customers' specifications.
(c) Heat-treating facilities.

Powell Pressed Steel Co., Hubbard, O.
(a) All types of large or small stampings.
(b) Material handling equipment, automobile, refrigerator, washing machine parts, etc.
(c) Complete facilities.

Pressed Steel Tank Co., 1435 S. 66th St., Milwaukee 14.
(a) Cylindrical deep-drawn shells and shapes; of mild and alloy steel, nickel, aluminum, stainless, bronze, X4130, etc.; approx. 5 to 29 in. inside diameter, and 10 to 60 in. depth, $\frac{1}{16}$ to ½-in. thick.
(b) Numerous types.
(c) Complete facilities.

R

Raymond Mfg. Co., Div. Associated Spring Corp., Corry, Pa.
(a) Small stampings of steel, brass, phosphor bronze, Monel, etc.
(b) Springs (both coil and flat), wire shapes and forms, etc.
(c) Heat treating facilities.

Reisner Mfg. Co. Inc., The W. H., 240 N. Prospect St., Hagerstown, Md.
(a) Flat and formed stampings, of brass, aluminum and steel, in 4-in. sizes.
(b) To customers' specifications.
(c) Machining and assembling facilities.

Reliable Spring Co., The, 3167 Fulton Rd., Cleveland.
(a) Blanking, forming, cutting of wire and strip in steel, stainless steel, brass, phosphor bronze, etc., flats to $\frac{3}{32}$ in. thick x 4 in. dia. and wire .006 in. to $\frac{3}{8}$ in. dia.
(b) Springs, wire formations, bends, hooks, handles, clips, etc.
(c) Heat treating and assembling.

Revere Products Corp., Phoenix, N. Y.
(a) Blanking, forming or drawing from light metals, steel, bronze, copper, stainless steel, aluminum, and brass, blanking to ¼ in. thick, forming to 36 in. long, drawing to 4 in. deep.
(b) Oil retainers, washers, escutcheons, etc.
(c) Complete facilities.

Rockford Metal Specialty Co., 716 Cedar St., Rockford, Ill.
(a) Drawing, forming, piercing of steel, stainless steel, aluminum, brass and zinc, approx. 10 in. dia. x 3½ in. cups; up to 16 in. dia. or sq. on shallow parts.
(b) Automotive and general stamping.
(c) Plating, riveting, welding, assembling and enameling.

Rockwood Sprinkler Co., 52 Harlow St., Worcester, Mass.
(a) Medium-heavy deep drawing and stamping of hot and cold-rolled steel; .02 to .375-in., ½ to 5 in. dia., 1 to 4 in. deep.
(b) Handles, pipe unions, pipe hangers.
(c) Sherardizing, parkerizing facilities.

S

Scovill Mfg. Co., Waterbury, Conn.
(a) Brass, bronze, nickel silver, copper, aluminum, steel, and other metal stampings, drawn shells, formed parts and metal assemblies, nonferrous forgings.
(b) To customers' specifications.
(c) Complete facilities.

Shunk Mfg. Co., Bucyrus, O.
(a) Blanking, forming and perforating, all types of materials.
(b) To customers' specifications.
(c) Complete facilities.

Smith Machine Co., H. A., 100 Hamilton Ave., Hopewell, N. J.
(a) Flat, drawn, formed; of brass, steel, bronze, beryllium copper and tin plate; to 6 x 6 in.
(b) Covers, housings and gears.
(c) Heat-treating facilities.

Stanley Works, The, Pressed Metal Div., New Britain, Conn.
(a) Flat, drawn and formed stampings of steel, brass, bronze and aluminum in all sizes.
(b) Various.
(c) Complete facilities.

Stolper Steel Products Corp., 3258 W. Fond du Lac Ave., Milwaukee.
(a) All types of sheet metal up to quarter inch.
(b) For automotive, agricultural, and industrial fields.
(c) Complete assembling facilities, welding.

T

Toledo Stamping & Mfg. Co., 99 Fearing Blvd., Toledo, O.
(a) Flat, drawn and formed hydrogen-furnace-brazed assemblies; of steel and bronze; in all sizes.
(b) Tractor frames, wheel guards, clutch housings, rocker arms, rocker shaft brackets, bomb fuses and adapters.
(c) Machining facilities.

Transue & Williams Steel Forging Corp., Alliance, O.
(a) Medium-sized stampings, blanked, formed, pierced and drawn, from hot and cold rolled steel, stainless steel, aluminum and Monel metal.
(b) All sizes and types of parts.
(c) Welding, brazing, punching and riveting.

Truscon Steel Co., Pressed Steel Div., 6100 Truscon Ave., Cleveland.
(a) Pressed steel stampings.
(b) From 20-gage on refrigerator stamping to heavier ones used for automotive parts.
(c) None.

W

Wallace Barnes Co., Div. of Associated Spring Corp., Bristol, Conn.
(a) Flat and formed stampings of spring steel, stainless and alloys in small sizes.
(b) Various.
(c) Heat-treating facilities.

Weber Bros. Metal Works, 108 N. Jefferson St., Chicago 6.
(a) Flat, drawn and formed brass, copper and steel stampings, heaviest being No. 14 gage, 6-in. dia.
(b) All types of machine parts.
(c) Machining, assembling facilities.

Western Cartridge Co., East Alton, Ill.
(a) Stamped and drawn; of brass, bronze, phosphor bronze, nickel silver, sheets, strips, coils.
(b) To customers' specifications.
(c) Information not available.

Whitehead Stamping Co., 1661 W. Lafayette Blvd., Detroit 16.
(a) Light, medium and heavy stampings.
(b) S.A.E. standard, U. S. standard, steel and brass washers.
(c) Complete facilities.

Williams, H. E., Products Co., 100-122 S. Main St., Carthage, Mo.
(a) Light stampings, sheet metal fabrication, steel and nonferrous metals, press size to 80 tons capacity.
(b) Automotive, electrical fluorescent light fixtures, etc.
(c) Turret lathes, screw machines, spot welders, plating, ovens for baking finishes.

Williams-Wallace Co., 160 Hooper St., San Francisco.
(a) Flat, formed, rolled, stamped, punched, $\frac{1}{16}$ to 30 gage; of steel, copper, brass, aluminum; to 15 x 45 in., 14 gage and lighter.
(b) Ordnance metal parts.
(c) Welding, finishing facilities.

Woodworth Specialties Co., 239 Water St., Binghamton, N. Y.
(a) Flat, shallow drawn, formed and punched stampings of steel, copper, brass, nickel, monel, stainless steel, nickel silver, aluminum, etc., in sizes requiring presses to 40 tons capacity.
(b) Electric terminals, shallow cups and collars, disks, rings, ferrules, etc.
(c) Machining and assembling facilities.

Worcester Pressed Steel Co., 111 Barber Ave., Worcester, Mass.
(a) Pressed metal stampings of any metal or alloy from ½ in. to 4 ft. dia., in lengths to 7 ft., using material from .002 to ½ in. thick, cold forgings at 1000 tons pressure.
(b) Automotive, airplane, oil burner, office equipment, transmission parts, etc.
(c) Complete facilities.

Worcester Stamped Metal Co. Inc., 9 Hunt St., Worcester, Mass.
(a) Light and heavy stampings of steel, brass, aluminum, copper and stainless steel, large and small.
(b) To customers' specifications.
(c) Annealing and hardening facilities.

Wrought Washer Mfg. Co., 2102 S. Bay St., Milwaukee.
(a) Stampings, blanking, forming, drawing, extruding, in all ferrous and nonferrous metals. Presses 300 ton capacity; material up to 1¼ in. thick.
(b) Washers, expansion plugs, automotive, etc.
(c) Complete facilities.

Forgings Producers

Reference letters beneath addresses of companies refer to: (a) Types, materials and sizes of forgings; (b) Names of forged machine parts customarily produced; and (c) Machining or heat-treating facilities.

A

Accurate Brass Co. Inc., 73rd Ave. and 88th St., Glendale, Brooklyn 27, N. Y.
(a) Press forgings of brass to 10 lb., copper to 4 lb., and aluminum to 2 lb.
(b) Parts for all types of machines.
(c) Machine facilities for brass forgings; aluminum forgings, heat treated.

Allegheny Ludlum Steel Corp., Brackenridge, Pa.
(a) Disks to 24 in. dia. x 5 in. thick; also special shapes; of high-speed steels, alloy and carbon tool steels, stainless and Nitralloy.
(b) Hardened machine parts, etc.
(c) Complete facilities.
See advertisement, Page 235

Alliance Drop Forging Co., P. O. Box 427, Alliance, O.
(a) Small drop forgings.
(b) To customers' specifications.
(c) Treated and shot blasted, not machined.

Aluminum Company of America, Gulf Bldg., Pittsburgh.
(a) Aluminum and magnesium; any sizes.
(b) Largely aircraft and aircraft engine parts.
(c) Heat-treating facilities.

American Brass Co., Waterbury, Conn.
(a) Hot-pressed copper, brass, bronze, nickel, silver, and special copper alloys in small sizes and shapes.
(b) To customers' specifications.
(c) None.
See advertisement, Pages 147-153

American Forge Co., 735 Ashley Ave., Berkeley, Calif.
(a) Hammered and pressed forgings to 40,000 lb. max., drop forgings to 15 lb. max., in steel, carbon steel and stainless.
(b) Diesel engine and other machine parts.
(c) Normalizing and annealing.

American-Forge Div., American Brake Shoe Co., 2621 S. Hoyne Ave., Chicago.
(a) Drop and upset forgings, of alloy and carbon steel.
(b) To customers' specifications.
(c) Complete heat-treating facilities.

American Hollow Boring Co., Erie, Pa.
(a) Hollow-bored forgings.
(b) Spindles, hydraulic cylinders, piston rods, clutch shafts, etc.
(c) Information not available.
See advertisement, Page 244

American Magnesium Corp., 2210 Harvard Ave., Cleveland.
(a) Hammered and pressed forgings, of magnesium alloys, in any size.
(b) To customers' specifications.
(c) Heat-treating facilities.
See advertisement, Page 118

Ampco Metal Inc., 1745 S. 38th St., Milwaukee
(a) All practical sizes, in copper base alloys.
(b) Aircraft parts and engines, machine tool, heavy machinery and chemical equipment.
(c) Complete facilities.
See advertisement, Page 137

Atlas Drop Forge Co., 209 W. Mount Hope Ave., Lansing 2, Mich.
(a) All sizes and shapes, any material, from few ounces to 500 lb.
(b) Farm implement, tractor, railroad, aviation, automotive, etc.
(c) Complete heat-treating facilities.

Atwater Mfg. Co., Plantsville, Conn.
(a) Drop and upset forgings of steel up to 20 lb.
(b) To customers' specifications.
(c) Heat treatment.

B

Benton Harbor Malleable Industries, Benton Harbor, Mich.
(a) Drop hammer steel forgings to 80 lb.
(b) To customers' specifications.
(c) Complete facilities.

Bethlehem Steel Co., Bethlehem, Pa.
(a) Open die forgings to 225,000 lb. in all grades of carbon and alloy steels—solid and hollow. Drop forgings from 1 to 350 lb. Also upset forgings.
(b) Shafts, rotors, rolls, gears and other press and hammer forgings.
(c) Complete facilities.

Billings & Spencer Co., The, 1 Laurel St., Hartford 6, Conn.
(a) All types in brass, bronze, stainless steel, alloys, straight carbon steel, Monel metal and tool steel; to 100 lb.
(b) Airplane, automobile, machine tool parts, gas and diesel engine, conveyor, mining machinery, typewriter parts, etc.
(c) Complete facilities.

Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit, Mich.
(a) Hot-pressed brass and aluminum forgings to 15 lb. in brass and to 10 lb. in aluminum, depending upon the design.
(b) To customers' specifications.
(c) Heat-treating facilities.

Bonney Forge & Tool Works, Allentown, Pa.
(a) Drop forgings from 1 oz. to 8 lb. of any grade steel, alloy or carbon, also small upset forgings.
(b) Machine handles, etc.
(c) Complete facilities.

Brewer-Titchener Corp., 111 Port Watson St., Cortland, N. Y.
(a) Ferrous, drop and upset forgings to 28 lb.
(b) Automotive and custom drop forgings.
(c) Complete facilities.

Buckeye Forging Co., 10001 Harvard Ave., Cleveland.
(a) Small forgings of carbon and alloy steels, stainless steels, brass and copper.
(b) Automotive, tractor, tank, etc.
(c) Machining facilities.

C

Cann & Saul Steel Co., 516 Commerce St., Philadelphia 6.
(a) Hammered and pressed, smooth forged or rough turned, steel (carbon, alloy and stainless) forgings of shafts or bars 18 in. in dia. max. (17,000 lb.), rings 42 in. outside dia. max., disks or hubs 33 outside dia. max. (2000 lb.).
(b) Shafts, bars, spindles, gear blanks, rings, ball races, etc.
(c) Heat-treating facilities.

Canton Drop Forging & Mfg. Co., Canton.
(a) Drop, upset, rolled and hammered forgings in steel only, to 600 lbs.
(b) Parts for aircraft engines, propellers, planes, automotive cars and trucks.
(c) Complete heat treating.

Capewell Mfg. Co., 60 Governor St., Hartford, Conn.
(a) Drop and hand forgings in steel and nonferrous metals, 12 lb. or less.
(b) Gears, levers, valves, or any part to specification.
(c) Complete heat-treating and cleaning facilities.

Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh.
(a) All type forgings produced with open dies, in all types of steel. Round—body diameter 68 in., max. collar diameter, 90 in., max. weight 220,000 lb. Rectangular—to 30 in. max. thickness, 150 in. max. width, with max. weight of 220,000 lb. Hollow rounds —max. outside diameter 140 in.
(b) Axles, bars, bridge pins, hexagon shafts, propeller shafts, rotors, locomotive parts, back-up rolls, sleeves, pinions, reduction gears, mill housings, etc.
(c) Complete facilities.
See advertisement, Page 120

Carpenter Steel Co., The, 120 Bern St., Reading, Pa.
(a) Simple forgings made on flat dies in all SAE, stainless and tool steels to 3000 lb.
(b) Rings, disks, blocks, simple shafts, axles, etc.
(c) All heat-treating facilities; minimum of machine wrok.
See advertisement, Pages 122-123

Champion Machine & Forging Co., 3695 E. 78 St., Cleveland.
(a) All type steel drop forgings to 3000 lb.
(b) To customers' specifications.
(c) Heat-treating facilities.

Chase Brass & Copper Co., Incorporated, 236 Grand St., Waterbury 91, Conn.
(a) Brass, naval brass, copper and copper alloy, and Olympic bronze.
(b) Automotive, aircraft, refrigeration parts, air valves, etc.
(c) Annealing, machining, polishing and plating facilities.

Clapp, E. D., Mfg. Co., 305 Genesee St., Auburn, N. J.
(a) Drop forgings of carbon, stainless steel, Monel, brass, bronze, copper, etc.
(b) Aircraft, automotive, railroad, tractor, etc.
(c) Complete facilities.

Cleveland City Forge Co., 4501 Lakeside Ave., Cleveland.
(a) Drop and upset forgings of carbon and alloy steel, from few ounces to several hundred pounds.
(b) To customers' specifications.
(c) Complete facilities.

Cleveland Hardware & Forging Co., 3270 E. 79th St., Cleveland.
(a) Drop and upset forgings in steel and brass.
(b) To customers' specifications.

(c) Complete facilities.

Clifford-Jacobs Forging Co., Box 264, Champaign, Ill.
(a) Drop forgings.
(b) Steel flanges, center plates, wedges, hubs, gears, connecting rods.
(c) Information not available.

Columbus Bolt Works Co., 291 Marconi Blvd., Columbus, O.
(a) Drop steel forgings, to 5 lb.
(b) To customers' specifications.
(c) Complete facilities.

Columbus Forge & Iron Co., The, 544 W. First Ave., Columbus, O.
(a) Steel alloy and plain carbon drop forgings; from ½ to 150 lb.
(b) Parts for automobiles, trucks, road and mining machinery, artillery, aircraft, tanks, etc.
(c) Semifinishing, normalizing and annealing.

Cornell Forge Co., 1659 W. 74th St., Chicago.
(a) All type drop forgings, from fraction of an ounce to 15 lb.; carbon steel, Monel, stainless steel, etc.
(b) Cams, crankshafts, pins, gears, hubs, valves, connecting rods, and war products.
(c) Annealing and shot blasting.

Crucible Steel Co. of America, 405 Lexington Ave., New York.
(a) All types of forgings in carbon and alloy grades, to 40 tons max. weight.
(b) Crankshafts, propeller shafts, piston rods, rams, gun forgings, rings, disks, etc.
(c) Complete facilities.

D

Davenport Besler Corp., 2305 Rockingham Rd., Davenport, Ia.
(a) Drop forgings and open steam hammer forgings.
(b) Crankshafts, connecting rods, levers, automotive and railway equipment.
(c) Complete facilities.

Dayton Forging & Heat Treating Co., The, 2323 E. First St., Dayton, O.
(a) Flat die forgings of SAE steel in all sizes to 30 in. diameter and 16 ft. long on bars to 12 in. diameter or 16 in. bars to 6 ft. long.
(b) Collets, bars, shafts, gear blanks, rings, bushings and spindles.
(c) Complete facilities.

Delaware Alloy Forge Co., 2300 E. Tioga St., Philadelphia.
(a) Flat die steam hammer work in stainless steel, tool steel, Nitralloy, Monel metal, bronze and other alloys from 1 to 5000 lb.
(b) Seat rings for large valves, knitting machine cylinders, paper machinery shafts, and gears.
(c) Complete facilities.

Dow Chemical Co., The, Midland, Mich.
(a) Magnesium alloy forgings.
(b) To customers' specifications.
(c) Heat-treating facilities.

Drop Dies & Forgings Co., 3097 E. 61st St., Cleveland.
(a) Drop forgings up to 25 lb.
(b) To customers' specifications.
(c) Heat-treating facilities.

Dyson & Sons, Joseph, Inc., 5125 St. Clair Ave., Cleveland.
(a) Steel and aluminum hammered and hydraulic pressed forgings in 2 to 2000 lb.
(b) Shafts, die blocks, spindles, weldless rings, gear blanks, bars, etc.
(c) Complete facilities.

E, F, G

Ellwood City Forge Co., Box 590, Ellwood City, Pa.
(a) Steel forgings, 25 to 35,000 lb.
(b) Crankshafts for aircraft, automobile, gas steam, or diesel engines.
(c) Complete facilities.

Endicott Forging & Mfg. Co. Inc., Endicott, N. Y.
(a) Drop and upset forgings, of carbon and alloy steels, Monel, stainless, Nitralloy, brass, copper and bronze, from 2 oz. to 80 lb.
(b) Gear blanks, crankshafts, connecting rods, rocker arms, etc.
(c) Heat-treating facilities.

Erie Forge Co., Erie, Pa.
(a) Flat die, press and hammered steel forgings.
(b) Marine, stationary engine crankshafts, etc.
(c) Complete facilities.

Falleen Drop Forge Corp., Filer City, Manistee Co., Mich.
(a) Steam hammer and upset forgings in carbon and alloy steels, ½ to 45 lb.
(b) To customers' specifications.
(c) Heat-treating facilities.

Finkl, A., & Sons Co., 2011 N. Southport Ave., Chicago.
(a) Hammer and press forgings in carbon and alloy steels from 5 to 50,000 lb.
(b) Shafts, rolls, rings, gear blanks, etc.
(c) Complete facilities.

Forging & Casting Corp., The, 1350 Jarvis Ave., Ferndale, Mich.
(a) Smooth hammered forgings, of S.A.E. grades of steel, ½ lb. to 1500 lb.
(b) Rings, blocks, disks, and irregular shapes.
(c) Annealing facilities.

Forgings & Stampings Inc., 23rd Ave. and Seventh St., Rockford, Ill.
(a) Drop forgings.
(b) To customers' specifications.
(c) Information not available.

Gardiner Mfg. Co., 2707 Union St., Oakland, Calif.
(a) Drop forgings to 12 lb. and also hammer and upset forgings to 5 in. round or square.
(b) Gearshift levers, bolts, etc.
(c) Machining facilities.

General Drop Forge Div., Brown-Lipe Gear Co., 1738 Elmwood Ave., Buffalo.
(a) Drop-forged and upset forgings, of carbon, stainless, Monel and other alloys, 1 oz. to 100 lb.
(b) Rings, gears, stem pinions, side gears, connecting rods, etc.
(c) Heat-treating facilities.

Globe Forge & Foundries Inc., Peat Street, Syracuse, N. Y.
(a) Drop and upset forgings in carbon and alloys from few ounces to 125 lb.
(b) Differential, transmission gears.
(c) Complete facilities.

H

Hammond & Irving Inc., 254 North St., Auburn, N. Y.
(a) Steam hammer forgings in alloy and tool steels, stainless, Nitralloy and Monel metals, to 1200 lb.
(b) Weldless rings, gear blanks, shafts, hammered bars, etc.
(c) Complete facilities.

Harrisburg Steel Corp., 10th and Herr Sts., Harrisburg, Pa.
(a) Alloy and carbon open-hearth steel drop forgings which can be produced on steam drop hammers from 2000 to 8000 lb.
(b) All types of machine parts.
(c) Complete facilities.

Harris-Thomas Drop Forge Co., 126 Harshman St., Dayton, O.
(a) Drop forgings.
(b) To customers' specifications.
(c) Information not available.

Harvey Spring & Forging Co., 17th & Murray Sts., Racine, Wis.
(a) Carbon and alloys, steel drop-hammered forgings, ¼ to 10 lb.
(b) Various machine parts.
(c) Annealing furnaces.

Henry & Allen Inc., 2-36 Wadsworth St., Auburn, N. Y.
(a) Drop and hammered forgings of carbon and alloy steel, under 1 lb. to 12 lb.
(b) Agricultural, automobile and commercial.
(c) Complete heat-treating facilities.

Heppenstall Co., 4622 Hatfield St., Pittsburgh. (Plants: Bridgeport, Conn., and Eddystone, Pa.)
(a) Forgings of carbon and alloy steels, to 45,000 lb. rough turned weight.
(b) Shafts, crankshafts, die blocks, shear knives, rolls, etc.
(c) Complete facilities.

Herbrand Corp., Fremont, O.
(a) Drop forgings of all types of steel.
(b) Automobile, aircraft, truck, etc.
(c) Heat-treating facilities.

I, J

Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago.
(a) Pressed forgings in aluminum (1½ x 3 in.) and brass (1¾ x 4 in.).
(b) Aircraft, automotive and refrigeration parts.
(c) Complete facilities.

Indiana Forge & Machine Co., Indiana Harbor Station, East Chicago.
(a) Steel drop forgings to 4 lb.
(b) Clutch hubs.
(c) Annealing only; no machining.

Interstate Drop Forge Co., 4041 N. 27th St., Milwaukee.
(a) Drop and upset forgings of carbon, alloy and stainless steel.
(b) Levers, gears, segments, hydraulic fittings, connecting rods, crankshafts, etc.
(c) Heat-treating facilities.

Jersey Forging Works, 803 Jersey Ave., Jersey City, N. J.
(a) Alloy steel and standard SAE steel forgings.
(b) Gear blanks, rings, sleeves, rolls, shafts, spindles, etc.
(c) Complete facilities.

Johnston & Jennings Co., 877 Addison Rd., Cleveland.
(a) Flat die forgings in plain carbon and alloy steels, 1 lb. to 5 tons.
(b) Spindles, solid and hollow-bored; rings, arbors, shafts, gears, etc.
(c) Complete machine shop facilities.

K

Kelly-O'Leary Steel Works, 5757 West 65th St., Chicago 38.
(a) Upset and hammered forgings of medium and mild stels and alloys to 6 in. dia. upsetting and to 10 in. dia. steam hammer.
(b) Gear blanks, special bolts, upset rods, stampings, welded assemblies and fabricated steel parts.
(c) Machining, drilling and punch press.

Keystone Forging Co., Northumberland, Pa.
(a) Drop forgings of steel, brass and other alloys not exceeding 3 lb.
(b) To customers' specifications.
(c) Complete facilities.

Koppers Co., Bartlett Hayward Div., 200 Scott St., Baltimore, Md.
(a) D-H-S bronze and steel-hammered forgings up to 40 carbon in 2 to 8 in. rounds.
(b) To customers' specifications.
(c) Complete facilities.

Kortick Mfg. Co., 345 First St., San Francisco.
(a) Drop, press and upset forgings.
(b) Airplane, engine, tractor, and other miscellaneous or special parts.
(c) None.

Kraeuter & Co. Inc., 585 Eighteenth Ave., Newark, N. J. (Drop Forging Div., Nye Ave. and S. Twentieth St., Irvington, N. J.)
(a) Closed die and upset forgings, of Monel, bronze and carbon, stainless and alloy steels, ½ oz. to 20 lbs.

(b) To customers' specifications.
(c) Limited facilities.

Kropp Forge Co., 5301 W. Roosevelt Rd., Chicago.
(a) Steam hammer to 20 tons; drop and upset.
(b) To customers' specifications; merchant bars, die blocks, flanges.
(c) Machining, heat treating, Magnaflux inspection.
See advertisement, Page 117

L

Ladish Drop Forge Co., Cudahy, Wis.
(a) Drop (up to 1000 lb.), hammered (up to 4000 lb.), and upset forgings of carbon and alloy steel.
(b) Aircraft, tractor, machine tool, etc.
(c) Machining and heat treating.
See advertisement, Page 143

Lakeview Forge & Clevis Co., Pittsburgh Ave., Erie, Pa.
(a) Drop forgings to 10 lb. in alloy or carbon steel.
(b) To customers' specifications.
(c) Heat-treating facilities.

Lamson & Sessions Co., The, Cleveland, Kent, Chicago and Birmingham, Ala.
(a) Small hot and cold upset forgings of any metal or alloy.
(b) Bolts, nuts, cotters, capscrews and special hot and cold upset products.
(c) Complete facilities.

Lansing Drop Forge Co., Logan and Albert Sts., Lansing, Mich.
(a) Drop forgings to 40 lb., upset forgings, coined and machined forgings, of all grades of carbon steel, Monel metal, aluminum and other alloys, from 2 oz. to about 40 lb.
(b) Steering arms, shift levers, small crankshafts, camshafts, shock absorber arms, rocker arms, gears, housings, etc.
(c) Complete facilities.

Larson, Charles E., & Sons Inc., 2645 N. Keeler Ave., Chicago.
(a) Large and small hammered forgings in iron and steel, high-carbon, high-chrome and other alloys.
(b) Miscellaneous parts.
(c) Complete facilities.

Latrobe Electric Steel Co., Latrobe, Pa.
(a) High-speed steel and stainless steel forgings, blocks and disks approx. 16 in. cube; flats approx. 20 x 10.
(b) Shear blades, disks, hobs, gear shaper forgings, etc.
(c) Heat-treating facilities.

Leard, William, Co. Inc., New Brighton, Pa.
(a) Hammered and hydraulic pressed steel forgings to 25,000 lb.
(b) Crankshafts, connecting rods and other type forged steel shafts.
(c) Complete facilities.

Letts Drop Forge Inc., 2714 W. Jefferson Ave., Detroit.
(a) Small and medium drop forgings in carbon and alloy bar stock.
(b) Automotive, aircraft, ordnance and maritime.
(c) None.

Lindell Drop Forge Co., S. Logan and N. Y. C. R. R., Lansing, Mich.
(a) Carbon and alloy steel forgings, from 1 oz. to 50 lb.
(b) For automotive, agricultural, mining machinery, etc.
(c) Limited machining.

M

Machinery Forging Co., The, 5450 Hamilton Ave., Cleveland.
(a) Flat die forgings of carbon and alloy steels, 1-2000 lb.
(b) Rings, disks, blocks, spindles, bars, hubs, etc.
(c) Rough turning only.

Maine Steel Inc., South Portland, Me.
(a) Drop and upset forgings in carbon steel, to 50 lb.
(b) Marine and industrial parts.
(c) Machining facilities.

Manganese Steel Forge Co., Richmond St. & Castor Ave., Philadelphia.
(a) Upset and pressed forgings in 11-14 per cent manganese steel to 50 lb.
(b) Headed pins.
(c) Complete facilities.

Melling Forging Co., 1401 Case St., Lansing, Mich.
(a) Steel drop forgings; from 1 oz. to 8 lb.
(b) To customers' specifications.
(c) Complete facilities.

Merrill Brothers, 56 Arnold Ave., Maspeth, Queens, N. Y.
(a) Drop forgings of steel and alloys, from fraction of oz. to 100 lb. or more.
(b) Turnbuckles, clevis nuts, shackles, eyebolts, hexagon sleeve nuts, etc.
(c) Information not available.

Mesta Machine Co., Box 1466, Pittsburgh.
(a) Very large steel and alloy steel forgings, both hollow and solid.
(b) Shafts, pinions, rolls, high pressure cylinders and reaction vessels.
(c) Complete facilities.

Midvale Co., The, Nicetown, Philadelphia.
(a) Press or hammer forgings, solid or hollow, in carbon or alloy steel.
(b) All types of parts.
(c) Complete facilities.

Milwaukee Forge & Machine Co., 1532 E. Oklahoma Ave., Milwaukee 7, Wis.
(a) Open-frame and drop-hammered forgings and weldless rolled steel rings in carbon and alloy steel, any size.
(b) Crankshafts, hub forgings, axles and weldless (seamless) rolled rings.
(c) Complete facilities.

Mitchell Steel Co., The, Stockyards Station, Cincinnati.
(a) Steam hammer forgings in plain carbon alloy and stainless steel.
(b) All types of machine parts, railroad, marine, etc.
(c) Complete facilities.

Moline Forge Inc., 4101 Fourth Ave., Moline, Ill.
(a) Dropped and pressed forgings of heat-resistant steel, carbon and alloys, within capacity of 2500 and 3000 lb. board drop hammer; pressed forgings for presses up to 300 tons.
(b) For oil field, small diesel engine, automotive, agricultural equipment parts, etc.
(c) Hardening and drawing furnaces.

Mondie Forge Co. Inc., 10300 Berea Rd., Cleveland.
(a) Drop forgings to 75 lb., upset forgings to 4 in., also gear blanks.
(b) To customers' specifications.
(c) Machining facilities.

Moore Drop Forging Co., 36 Walter St., Springfield, Mass.
(a) Drop, upset and coined forgings.
(b) To customers' specifications.
(c) Heat treating and machining.

Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
(a) Drop hammered and pressed forgings of brass, bronze, copper, aluminum and alloys; 1 oz to 25 lb.
(b) To customers' specifications.
(c) Complete facilities.

N, O

National Forge & Ordnance Co., Irvine, Warren County, Pa.
(a) Hammered and pressed steel forgings.
(b) Rough or finished parts.
(c) Complete machining facilities.
See advertisement, Page 242

National Lock Washer Co., 40 Hermon St., Newark, N. J.
(a) Small drop forgings.
(b) Steel rod ends in adjustable yoke, plain yoke and eye types; steel clevis pins for steel rod ends; steel plugs, rings, and flanges, all in standard sizes, and various custom forgings to order.
(c) Heat treating and machining.

Octigan Forge & Mfg. Co., 2428 S. Lowe Ave., Chicago.
(a) Drop forgings.
(b) To customers' specifications.
(c) None.

Ohio Forge & Machine Corp., 3010 Woodhill Rd., Cleveland.
(a) Drop, upset and flat hammer steel forgings in all sizes.
(b) Precision gears, spline shafts, power transmitting equipment.
(c) Complete heat treating, machining for gears and shafts only.

Oliver Iron & Steel Corp., N. E. Corner S. 10th and Muriel Sts., Pittsburgh.
(a) Small forgings in iron, steel and alloys in sizes of 8 in., and weight of 5 lb. Large and small upset bars.
(b) Bolts, nuts, rivets, hot or cold headed special parts of all kinds.
(c) Complete facilities.

Owensboro Forging Co., Owensboro, Ky.
(a) Drop forgings.
(b) To customers' specifications.
(c) Heat-treating facilities.

P

Pacific Car & Foundry Co., Renton, Washington.
(a) Hammered, drop and upset forgings of steel; to 8 in.
(b) Gears, pistons, connecting links, etc.
(c) Complete facilities.

Park Drop Forge Co., The, 730 E. 79th St., Cleveland.
(a) All types of drop steel forgings to 4000 lb.
(b) Crankshafts, connecting rods, camshafts, axles, gears, etc.
(c) Complete machining, heat treating.

Pettibone Mulliken Corp., 4710 W. Division St., Chicago.
(a) Drop, hammer and upset forgings in alloy and carbon steels, from 1 oz. to 20 lb.
(b) Automotive and railroad parts.
(c) Limited machining and heat treating.

Philadelphia Hardware & Malleable Iron Works, 7500 State Rd., Philadelphia.
(a) Drop steel forgings not over 30 lb. nor more than 9 in. dia. or 18 in. long.
(b) Turnbuckles, eyebolts, etc.
(c) Drilling and tapping.

Phoenix Mfg. Co., Front & Chapel Sts., Catasauqua, Pa.
(a) Drop forgings to 40 in.
(b) Journals, yokes, welding flanges, clevises, also commercial forgings of various types and designs.
(c) Machining facilities.
See advertisement, Page 247

Pittsburgh Forgings Co., Thorne street, Coraopolis, Pa.
(a) Drop and upset forgings of carbon, alloy and stainless steel, from 1 oz. to 200 lb.
(b) Automotive, farm equipment, tractor, railroad, etc.
(c) Milling, drilling, tapping; full heat treating.

Pittsburgh Forgings Co., Riverside Div., Jackson, Mich.
(a) Drop forgings, from 3 to 50 lb.
(b) Specialty, automotive hubs and tractor wheels.
(c) Complete facilities.

Pittsburgh Trolley & Forge Co., 117 Water St., Pittsburgh.
(a) Forgings in carbon and alloy steels, to 2000 lb.
(b) Spindles, shafts, gears, rings, etc.
(c) Complete facilities.

Poor & Co., Canton Forge & Axle Works, 2027 Dueber Ave., S. W., Canton, O.
(a) Drop die and upset forgings in carbon and alloy steels, 1 to 350 lb.

(b) Spindles, levers, gears, etc.
(c) Heat-treating facilities.

Porter Forge & Furnace Inc., 6 Ashland St., Everett, Mass.
(a) Drop forgings of standard and special steels and metals.
(b) To customers' specifications.
(c) Complete heat-treating facilities.

Portland Forge & Fdry. Co., Portland, Ind.
(a) Board hammer, upset forgings of steel bars, to 60 lb.
(b) Gears, etc.
(c) Complete facilities.

R, S

Revere Copper & Brass Inc., 230 Park Ave., New York 7.
(a) Die pressed and hammered forgings, of brass, bronze, copper, nickel silver, cupronickel, silicon bronze (Herculoy), aluminum and magnesium.
(b) To customers' specifications.
(c) Complete facilities.

Rhode Island Tool Co., 148 W. River St., Providence, R. I.
(a) Drop forgings of carbon, alloy and stainless steels, 10 in. dia., 1½ in. thick; 2 in. dia., 18 in. long.
(b) Bolts and nuts and screw machine products.
(c) Heat-treating facilities.

Rockford Drop Forge Co., 1033 Ninth St., Rockford, Ill.
(a) Drop forgings.
(b) Automotive and industrial clutches, etc.
(c) Information not available.

Rome Mfg. Co. Div., Revere Copper & Brass Inc., Railroad St., Rome, N. Y.
(a) Hot-pressed forgings in brass, copper and related alloys; aluminum and magnesium.
(b) To customers' specifications.
(c) Complete facilities.

St. Pierre Chain Corp., 50 Frank St., Worcester, Mass.
(a) All types of forgings of alloys, soft steels, etc., 1 oz. to 50 lb.
(b) Automobile, airplane and other machine parts.
(c) Complete facilities.

Scovill Mfg. Co., Waterbury, Conn.
(a) Made-to-order forgings from brass, bronze, copper, and aluminum.
(b) To customers' specifications.
(c) Complete facilities.

Shuler Axle Co. Inc., 2901 S. Second St., Louisville, Ky.
(a) All type forgings in carbon and alloy steel, 1 to 300 lb.
(b) Automotive and trailer axles, also heavy-duty two-shoe brakes.
(c) Complete facilities.

Smith-Armstrong Forge Inc., 1209 Marquette Rd., Cleveland.
(a) Hammered forgings in S.A.E. steel specifications; 2-3000 lb. depending upon type of forging; hammer capacity 1100-3500 lb.
(b) Automotive and machine tools.
(c) Machining facilities.

Snell Mfg. Co., Fiskdale, Mass. (factory); 149 Washington St., Worcester, Mass. (office).
(a) Hammered and drop, carbon and alloy steel forgings, ¼ to 1½ lb.
(b) Ship augers, gun parts, etc.
(c) Heat-treating facilities.

Southern Saw Works Inc., East Point Rd., Atlanta, Ga.
(a) Drop hammer forgings in carbon and alloy steels to approximately ½ lb. depending on design and shape.
(b) Bits and shanks for inserted tooth saws, wrenches, commercial per specifications.
(c) Heat-treating facilities.

Spencer Mfg. Co., Spencer, O.
(a) Rolled and upset forgings.
(b) Axle forgings.
(c) Complete facilities.

Steel Improvement & Forge Co., 970 E. 64th St., Cleveland.
(a) Drop hammer, upset and press forging.
(b) Machine tool, aircraft, automotive, truck and tractor, marine and coal industries.
(c) Complete facilities.
See advertisement, Page 229

Steel, R., & Sons Inc., 4221 Ninth St., Long Island City 1.
(a) Carbon and alloy steel hammered forgings in 10 in. square or round, and under.
(b) Various.
(c) Machining facilities.

Storms Drop Forging Co., P. O. Box 2050, Springfield, Mass.
(a) Drop forgings, from fraction of ounce to 50 lb., in all grades of forgeable materials; also hot pressed brass forgings.
(b) To customers' specifications.
(c) Complete heat treating.

T

Taylor Forge & Pipe Works, P. O. Box 485, Chicago.
(a) Drop, upset and hammer forgings of carbon and alloy steels, some nonferrous metals, to 114 in. o.d.
(b) Flanges, rings, nozzles, necks, gear blanks, etc.
(c) Complete facilities.
See advertisement, Page 244

Taylor-Wharton Iron & Steel Co., (Easton, Pa. plant), High Bridge, N. J.
(a) Pierced and drawn forgings to 13 in. in dia., specializing in high-pressure gas cylinders.
(b) To customers' specifications.
(c) Complete facilities.

Transue & Williams Steel Forging Corp., Alliance, O.
(a) All sizes and types of drop forgings from 1 oz. to 1000 lb. of carbon steels, alloys and nonferrous metals.
(b) Various sizes and types of connecting rods, crankshafts, camshafts, bearing caps, driveshafts and gears.
(c) Complete heat treating.

U, V, W

Unit Drop Forge, Div. of Fuller Mfg. Co., 1903 South 62nd St., West Allis, Wis.
(a) Hammered, drop and upset steel and bronze forgings, 1 to 400 lb.
(b) Transmission countershaft gears.
(c) Heat-treating facilities.

Union Forging Co., Endicott, N. Y.
(a) Drop and press forgings.
(b) Automotive parts.
(c) Heat-treating facilities.

Vichek Tool Co., 3001 E. 87th St., Cleveland.
(a) Drop steel forgings, to 3 lb.
(b) To customers' specifications.
(c) Complete machine shop, automatic furnace.

Vulcan Steam Forging Co., 223-257 Rano St., Buffalo, N. Y.
(a) Open die forgings of carbon, alloy, tool and stainless steels, and nonferrous metals.
(b) Gear blanks, crankshafts, piston rods, levers, spindles, rolls, weldless rings, shaped work.
(c) Complete facilities.

Wilcox Mfg. Co., The D., N. Chestnut and E. Allen Sts., Mechanicsburg, Pa.
(a) Drop forgings of alloy and carbon steel, 1 oz. to 30 lb.
(b) To customers' specifications.
(c) Information not available.

Williams, J. H., & Co., 400 Vulcan St., Buffalo, N. Y.
(a) Drop forgings in steel and nonferrous metal from ½ oz. to 100 lb.
(b) Structural forged parts, gears, levers, cams, cranks, etc., for machine tools, gas engines, compressors, aircraft, automotive, etc.
(c) Complete facilities.
See advertisement, Page 234

Wyman-Gordon Co., Worcester, Mass., and Harvey, Ill.
(a) Drop hammer, upset and press forgings in steel and aluminum from 10 to 500 lb.
(b) Automotive and aviation.
(c) Heat-treating facilities.

Machine Die Castings Producers

Reference letters beneath addresses of companies refer to: (a) Types, materials and sizes of die castings; (b) Names of die-cast parts customarily produced; and (c) Machining, finishing and assembling facilities.

A

AC Spark Plug Div., General Motors Corp., 1300 N. Dort Highway, Flint, Mich.
(a) Zinc base and aluminum base alloy die castings, from small speedometer parts to castings 26 x 20 inches.
(b) Automotive and aircraft parts.
(c) Complete facilities.

Aluminum Co. of America, 634 Gulf Bldg., Pittsburgh.
(a) Aluminum alloy and zinc die castings, all types and sizes.
(b) To customer's specifications.
(c) Complete finishing facilities.

American Magnesium Corp., 2210 Harvard Ave., Cleveland.
(a) Low and high pressure die castings of various magnesium alloys, in any size.
(b) To customers' specifications.
(c) Light machining.
See advertisement, Page 118

Apex Smelting Co., 2537 W. Taylor St., Chicago.
(a) Aluminum die castings, and zinc base die castings under ZAMAK trademark.
(b) To customers' specifications.
(c) Information not available.

Aurora Metal Co., 614 W. Park Ave., Aurora, Ill.
(a) Aluminum bronze and silicon bronze die castings.
(b) To customers' specifications; including such parts as automotive, farm equipment, machine tool, etc.
(c) Information not available.

B

Badger Die Casting Co., 1570 S. First St., Milwaukee 4.
(a) Zinc and aluminum alloy die castings, from very small to 10 lb. in zinc and 5 lb. in aluminum.
(b) Aircraft instrument parts, small gasoline engine parts, carburetors, etc.
(c) Complete facilities.

Benton Harbor Malleable Industries, Benton Harbor, Mich.
(a) Special high-grade zinc, virgin aluminum and copper die castings, not to exceed 5 lb.
(b) Machine tool parts, etc.
(c) Machining.

Borman Castings Corp., St. Joseph, Mich.
(a) Zinc, aluminum, magnesium and lead die castings in sizes corresponding to a 6-lb. zinc casting.
(b) Washing machine, automotive and aircraft parts.
(c) Limited facilities.

C, D

Chicago Die Casting Mfg. Co., 2510-14 W. Monroe St., Chicago.
(a) Zinc base alloy die castings in sizes of 14 x 12 x 4 in.
(b) All types of machine parts.
(c) Complete facilities.

Congress Die Castings Div., 3750 E. Outer Drive, Detroit.
(a) Zinc alloy die castings, to 10 lb.; also aluminum.
(b) Pulleys, flexible couplings, vending machine, washing machine, radio, woodworking machine and automotive parts.
(c) Complete facilities.

Die Cast Corp., 666 Hawthorne St., Glendale 4, Calif.
(a) Aluminum, manganese bronze and magnesium die castings; up to 3 lb. in aluminum and 5 lb. in manganese bronze.
(b) Aircraft and bomb parts.
(c) Facilities for all the above.

Doehler Die Casting Co., Toledo, O., (Other plants at Batavia, N. Y., and Pottstown, Pa.)
(a) Zinc, aluminum, brass, bronze, tin, lead and magnesium die castings.
(b) All types of machine parts.
(c) Machining and finishing facilities.

Dollin Corp., 610 S. 21st St., Irvington, N. J.
(a) All sizes, in aluminum and zinc alloys.
(b) All types of die-cast machine parts.
(c) Machining and trimming facilities; cold chamber, high-pressure and other standard and special equipment.

Dow Chemical Co., The, Midland, Mich.
(a) Dowmetal, magnesium alloy, die castings.
(b) All types of automotive, aircraft and other machine parts.
(c) None.

F, H

Federal Die Casting Co., 2222-32 Elston Ave., Chicago 14.
(a) Zinc and aluminum die castings, 16 lb. in zinc and 2 lb. in aluminum.
(b) Parts for radios, automobiles, stokers, airplanes, etc.
(c) Complete facilities.

Federal-Mogul Corp., 11031 Shoemaker Ave., Detroit.
(a) Tin and lead base, medium and small die castings.
(b) Primary bearings and bushings.
(c) Complete facilities.

Harvill Corp., 6251 W. Century Blvd., Los Angles 43.
(a) Aluminum, magnesium, manganese-bronze and zinc alloy die castings, up to approx. 16 x 24 in., and 8 lb. in weight.
(b) All types of machine parts.
(c) Machining.

Heick Die Casting Corp., 4061 Schubert Ave., Chicago.
(a) Aluminum and zinc alloy die castings, from ½ oz. to 4 lb.
(b) Brackets, pulleys, levers, frames, etc.
(c) Assembling and machining facilities.

Hoover Co., The, Maple and McKinley Sts., North Canton, O.
(a) Aluminum and zinc die castings, to 24 in. square.
(b) To customers' specifications.
(c) Complete facilities.

L, M

Latrobe Die Casting Co., North and Unity Sts., Latrobe, Pa.
(a) Zinc, aluminum, tin and lead alloy die castings; aluminum, 5 lb., zinc, 8 lb., tin and lead, 2 lb.
(b) All types in weight range.
(c) Machining and finishing facilities.

Madison-Kipp Corp., 210 Waubesa St., Madison, Wis.
(a) Zinc and aluminum die castings, all sizes.
(b) Automotive, household appliance, railway, ordnance parts, etc.
(c) Complete facilities.
See advertisement, Page 140

McGill Mfg. Co., Metal Div., Valparaiso, Ind.
(a) Aluminum, bronze and special hard bronze die castings, from ½ oz. to 10 lb. Hydraulic pressure castings of hard yellow brass and silicon bronze, ½ oz. to 2 lb.
(b) Great variety of machine parts including gears, levers, and other corrosion-resistant machine parts.
(c) Complete facilities.

Michigan Die Casting Co., 8651 E. 7 Mile Road, Detroit.
(a) Zinc, aluminum and magnesium die castings; to 25 lb. in zinc, 10 lb. aluminum and 2 lb. magnesium.
(b) Automotive and aircraft parts.
(c) Complete facilities.

Milwaukee Die Casting Co., 1015 N. Fourth St., Milwaukee 3.
(a) Zinc to 5 lb.; aluminum to 4 lb.; lead, tin to 14 lb.
(b) Motor cases, electrical apparatus, ordnance, aircraft, bomb parts, fuses, etc.
(c) Machining and finishing facilities.

Monarch Aluminum Mfg. Co., Dycast Products Div., 9301 Detroit Ave., Cleveland.
(a) Zinc and aluminum base alloy die castings; in zinc to approx. 15 lb., in aluminum, approx., 5 lb.
(b) Automotive, radio, refrigeration, electrical, cases, vending machine, etc.
(c) Machining and assembling facilities.

Mt. Vernon Die Casting Corp., 118 Pearl St., Mount Vernon, N. Y.
(a) Aluminum and zinc; up to 18 lb. in zinc, and 10 lb. in aluminum.
(b) Numerous machine parts.
(c) Machining facilities.

N, P

National Lock Co., 1902 Seventh St., Rockford, Ill.
(a) Zinc die castings to 12 in.
(b) To customers' specifications.
(c) Complete facilities.

New Products Corp., 448 North Shore Drive, Benton Harbor, Mich.
(a) Aluminum, brass, magnesium and zinc die castings; up to 5 lb. in aluminum; 1 lb. in brass; 15 lb. in zinc; and 2 lb. in magnesium.
(b) Airplane carburetor parts, rotary pump assemblies, fuse parts, airplane air-speed indicators, etc.
(c) Complete facilities.

Newton-New Haven Co., New Haven 4, Conn.
(a) Aluminum, magnesium and zinc alloy die castings, up to medium-large.
(b) Aircraft instrument parts.
(c) Complete facilities.

Parker White Metal & Machine Co., McKinley Ave., at 23rd St., Erie, Pa.
(a) Zinc and aluminum base die castings in any size.
(b) All types of machine parts.
(c) Complete facilities.

Precision Castings Co., Inc., Fayetteville, N. Y. (Branch, Cleveland, O.; Die Shop, Syracuse, N. Y.)
(a) Aluminum and zinc castings from fraction of ounce to 26 lb.
(b) Automotive, household appliances, out board motors, etc., and to customers' specifications.
(c) Machining, assembling facilities.

Pressure Castings Inc., 21500 St. Clair Ave., Cleveland.
(a) Zinc and aluminum alloy die castings to 24 x 24 in.
(b) To customers' specifications.
(c) Finishing and machining facilities.

S, T

Schultz Die Casting Co., 1810 Clinton St., Toledo, O.
(a) Zinc base die castings.
(b) Automotive, etc.
(c) Machining and finishing facilities.

Superior Die Casting Co., 17325 Euclid Ave., Cleveland.
(a) Zinc and aluminum alloy die castings.
(b) Ordnance, aircraft and various machine parts.
(c) Information not available.

Titan Metal Mfg. Co., Bellfonte, Pa.
(a) Brass and bronze pressure die castings, up to 2 lb.
(b) Electrical, refrigeration, and miscellaneous parts.
(c) Machining and assembling.

Toman, E., & Co., 2621 W. 21st place, Chicago 8.
(a) All types of zinc base die castings from ½ oz. to 8 lb.
(b) To customers' specifications.
(c) Complete facilities.

Machine Finishes Producers

Reference letters beneath addresses of companies refer to: (a) Trade-name and type of finish, availability in color; (b) Method of application and drying; and (c) Characteristics and use of finish.

A

Acme White Lead & Color Works, 8250 St. Aubin Ave., Detroit.
(a) Nitro-cellulose lacquers, oil and varnish types.
(b) Information not available.
(c) Protection against rust, absorption of oil, and decorative purposes.

Alrose Chemical Co., P. O. Box 1294, Providence, R. I.
(a) JETAL, black finish for ferrous metals; OXIDINE Z, a black nonreflecting finish for zinc and zinc plate; OXIDINE B, a black finish for copper and brass; OXIDINE CI, black finish for cast iron; BON WHITE, lustrous immersion tin finish for brass and copper.
(b) Chemical oxidation by immersion.
(c) Decorative, rustproofing, heat-resisting; for machines and appliances.

Aluminum Co. of America, Gulf Bldg., Pittsburgh.
(a) ALROK (aluminum oxide) colorless, bluish or greenish grey, dyed colors. ALUMILITE (aluminum oxide) colorless, dyed colors.
(b) Alrok—chemical; Alumilite—electrolytic.
(c) Alrok, corrosion and abrasion resistant; applied to aluminum parts for protection or as surface preparation for painting. Alumilite, better resistance to corrosion and abrasion; used for protection and decorative applications.

Aluminum Industries Inc., 2438 Beekman St., Cincinnati.
(a) PERMITE lacquer enamel or enamel, in all shades of gray.
(b) For brushing and spraying, or drying by air.
(c) Rustproofing and protection of all types of machine parts.

American Products Mfg. Co., Oleander & Dublin Sts., New Orleans, La.
(a) INCELOID cellulose and resin bases, in all colors and iridescent.
(b) May be applied by any method; atmosphere and oven dried.
(c) Decorative; on all standard types of machines.

Apollo Metal Works, 6605 S. Oak Park Ave., Chicago.
(a) APOLLO pre-chromed metal, in bright and satin chrome and satin striped patterns.
(b) Plating.
(c) For conserving brass, copper, aluminum, nickel where corrosion resistance or reflectivity is desired.

Arco Co., The, 7301 Bessemer Ave., Cleveland.
(a) ARCO lacquers, synthetics and oil enamels; available in standard machine tool gray or special shades. INFRAY paint in standard colors of the U. S. Army Engineers Corps.
(b) Adaptable for any application method; air or force dried.
(c) Arco is rust, heat and oil resistant, for all industrial machinery, and INFRAY is infra-red-reflecting, heat-reflecting and low visibility paint, developed primarily to meet war needs.

Armstrong Paint Varnish Works, 1330 S. Kilbourn Ave., Chicago.
(a) ARMSTRONG paint, lacquer, enamel, varnish, etc., in all colors.
(b) All methods of drying and application.
(c) Rustproofing, decorative and heat-resisting; on all types of machines.

Ault & Wiborg Corp., 350 Fifth Ave., New York 1.
(a) POLYMERIN speedbake enamel, WRINKLE enamel, AULTONE lacquers, and PROTEKTOL stripping lacquer; all available in colors.
(b) POLYMERIN and WRINKLE applied by spraying and dipping; baked (all methods including infra-red). AULTONE applied by spraying; air-dried. PROTEKTOL applied by brushing and spraying; air-dried.
(c) Decorative, protective, heat and cold-resistant; for any part suitable for baking or other drying schedules.

B

Baltimore Enamel & Novelty Co., P. O. Box 928, Baltimore 3.
(a) DURA-SHEEN porcelain enamel; paint and lacquer; in any color.
(b) Paint, lacquer applied by brushing, dipping and spraying; automatic and air drying.
(c) Used for rustproofing, decoration; is heat-resistant; for panels, small machinery, metal assemblies and exhaust tubes.

Berry Brothers, 211 Leib St., Detroit 7.
(a) BERRY No. 10 synthetic gray primer; No. 97 blue gray synthetic machinery enamel (semigloss); No. 5 red pyroxylin primer; No. 26 blue gray synthetic machinery lacquer; No. 625 red oxide primer; and No. 16BQ.D. blue gray machinery enamel (semigloss).
(b) No. 625 may be brushed or sprayed and dries over night; No. 16B recommended for spraying, is dust-free in 30 minutes and dries in 3-4 hours; Nos. 10 and 97 are fast air-drying synthetics.
(c) No. 10 is used for castings and sheet steel. All are used for general machinery purposes.

Bownes, Frank Co., Chelsea, Mass.
(a) MODENE, mill whites and synthetic enamels and special finishes.
(b) For spray, brush and dip; air dried and baked.
(c) Decorative, protective; for machine tools.

C

Chemical Research Corp., P. O. Box No. 2002 Tulsa 1, Okla.
(a) RESISTAL HCL-340-A, -400, G-100, M-600; water-clear coatings, for metals and alloys.
(b) All can be brushed, sprayed or dipped, while G-100 type can be applied by roller coating methods; dry dust-free in 10 minutes.
(c) G-100 has excellent adhesion to all wood and metal surfaces; HCL-340-A to all metal aircraft exteriors without use of primer; all are tough, nonporous, durable, and have high dielectric strength.

Chicago Vitreous Enamel Product Co., Armor-Vit Div., 1425 South 55th Court, Cicero, Ill.
(a) ARMOR-VIT inorganic finish; in black, green, and olive drab.
(b) Sprayed.
(c) Rustproofing, heat-resistant, thermal shock resistant, resistant to acids, alkalies, abrasion; for iron and steel and at present largely applied to Army and Navy materiel.

Chromium Corp. of America, 120 Broadway, New York. (Plants in Waterbury, Conn., Cleveland and Chicago.)
(a) CRODON chromium plating (also copper, nickel, etc.).
(b) Electroplating.
(c) Decorative, rustproofing, hardness; for various types of machines.

Cooper Alloy Foundry Co., 200 Bloy St., Hillside, N. J.
(a) LUSTRACAST electrolytic finish.
(b) Electroplating.
(c) Decorative, protective.

Creutz Platers Inc., S.E. Third and Vine, Cincinnati 2.
(a) Gold, silver, copper, nickel, cadmium; anodizing, lacquering and plating.
(b) Plating, spraying, etc.; oven, air drying.
(c) Decorative and for rustproofing.

D

Day, James B., & Co., 1872 Clybourn Ave., Chicago.
(a) NITROLITE lacquer enamel; and a synthetic baking enamel.
(b) Lacquer sprayed or dipped and air dried; enamel sprayed and baked.
(c) Decorative; for metal machine part.

Densol Paint Co., 9808 Meech Ave., Cleveland.
(a) DENSOTECH and DENSOL machine tool finishes. Former available in clear liquid, latter in NTBA gray, light gray, maroon, red, olive green and white.
(b) For brushing, spraying or dipping.
(c) Former for rustproofing and to preserve bright-plated finish on metal parts; DENSOL for use on all types of machine tools.

Dibble Color Co., 1497 East Grand Blvd., Detroit.
(a) DIBBLE standard machinery finishes in gray, black, white and red.
(b) For brushing, spraying; air drying, baking.
(c) Rustproofing; for milling and broaching machines, lathes, presses, etc.

DiNoc Mfg. Co., 1700 London Rd., Cleveland.
(a) DI-NOC film involving special process to reproduce wood grains and other effects.
(b) May be applied to steel, wood and composition material, or furnished in form of prefinished sheets.
(c) Heat, cold and salt spray resistant; for radios, automobiles, airplanes, air conditioning units, business machines and similar equipment.
Can only be furnished for War contracts due to allocation of vital materials.

Du-Lite Chemical Corp., Middletown, Conn.
(a) DU-LITE black oxide steel finish.
(b) Dipped.
(c) Rustproofing, decoration; tough; uniform; for aircraft, tank and marine engines, arms bomb parts, cartridge clips, instruments, and machine parts.
See advertisement, Page 250

Durez Plastics & Chemicals Inc., North Tonawanda, N. Y.
(a) DUREZ protective coating resins, in clear, black, white, or colors.
(b) For air drying, baking, or direct heat or infra-red.
(c) Alkali, acid, solvent, and oil-resistant; weather-resistant primers for ferrous and nonferrous metals, and for finishing coats.

E

Egyptian Lacquer Mfg. Co., 1270 Sixth Ave., New York.
(a) EGYPTIAN lacquers and synthetics, in clear and standard colors; also to match.
(b) For spraying, dipping or brushing; air drying and baking.
(c) For protection and decoration, on all types of metal, and machine tools.
See advertisement, Page 252

Enterprise Galvanizing Co., Cumberland & Almond Sts., Philadelphia.
(a) Hot dip galvanizing zinc silver-colored finish.

(b) For dipping.
(c) For use where corrosion resistance is required; in laundry machines, refrigeration, ice, textile and electrical machines, etc.

Erie Enameling Co., Erie, Pa.
(a) ERIE porcelain, inorganic, in any standard color.
(b) Dipping and spraying; fused in cast iron or steel.
(c) Acid, rust and corrosion resisting, providing slippery glass-hard surface; for chemical conveyor buckets, bed plates, photographic equipment, pipes and valves.

F

Ferro Enamel Corp., 4150 East 56th St., Cleveland.
(a) FERROC inorganic porcelain finishes; in all colors and shades.
(b) For spray; dip fire at approx. 1500 degrees Fahr.
(c) Decorative, rustproofing, cleanliness; for food, chemical processing, textile machinery, etc.

Forbes Varnish Co., 3800 W. 143d St., Cleveland.
(a) NITROLOID light primer HV-8175 and NITROLOID 7B NMTB machinery gray HV-4209 lacquer.
(b) Sprayed; air dried.
(c) General protection, oil resistant; for all light and heavy machinery.

Frazer Paint Co., 2475 Hubbard, Detroit.
(a) FRATEX synthetic enamel and TUFTEX machinery enamel; former in 20 standard enamels or special colors to match; latter in 10 standard shades or special to match color.
(b) For spray or brush; air dry.
(c) For decoration and protection for all metal machinery.

G, H

Glidden Co., Madison Ave. and Berea Rd., Cleveland.
(a) VULCOTE finish in type required; in any color if volume permits; principally machine tool gray.
(b) Principally sprayed, air-dried or baked.
(c) Protective; oil, and abrasion-resistant; for all types of machinery.

Hague, Alfred, & Co., Inc., 227—34th St., Brooklyn.
(a) RUBALT No. 269 enamel; available in custom colors.
(b) Can be applied by any method; air dried or low baked.
(c) Rustproofing; for any type of machinery.

Haynes Laboratories Inc., C. W., Chandler St., Springfield, Mass.
(a) Lacquers and synthetics in any color.
(b) Brush and spray; air dry.
(c) For coating any type of machine.

Heathath Corp., Box 78, Springfield, Mass.
(a) PX finish available in black; PENTRATE, penetrating oxide in black only.
(b) Immersion in boiling solution; air-dried.
(c) PZ for stainless steel, cast and malleable iron parts; PENTRATE for all types, being rust-resisting, friction reducing, and having durability and good appearance.

Heresite & Chemical Co., 822 South 14th St., Manitowoc, Wis.
(a) HERESITE phenol-formaldehyde resin finish in brown, gray, black, olive green and cream; VR500 air-drying series, in black, brown and gray.
(b) HERESITE is sprayed, dipped, flow and roller coated; oven-baked. VR500 applied by spraying, dipping and brushing.
(c) HERESITE is acid-resistant, rustproofing and salt water-resistant; for rayon and textile machinery, torpedo parts, tank cars, etc. VR500 is acid and alkali-resistant; for rayon and textile and paper mill machinery, etc.

Hilo Varnish Corp., 42 Stewart Ave., Brooklyn.
(a) HILO paints, lacquers, enamel synthetics in all colors; varnish, etc., also black japans, and protective coatings to meet government specifications.
(b) For brushing, spraying, dipping, flow coating, roller coating, and tumbling; infra-red and air drying.
(c) Used for rustproofing and protecting all types of machines, equipment, etc.; also for protective concealment.

Hollingshead Corp., R.M., 840 Cooper St., Camden, N. J.
(a) WHIZ rust preventative compounds.
(b) Sprayed, dipped or brushed.
(c) For rustproofing; used by U. S. Govt. for internal and external protection of all kinds of automotive and aircraft engines, etc.; as well as protection of rough castings and newly machined metal parts.

Hommel, O., Co., 209 Fourth Ave., Pittsburgh.
(a) HOMMELAYA process of vitreous enameling in any color or shade.
(b) For spray or dip; drier equipment.
(c) Decorative, rustproof or heat resistant; for any type of machine.

Hooker Glass & Paint Mfg. Co., 651 Washington Blvd., Chicago.
(a) KING machine and engine enamel available in color; No. 6132 standard machine tool gray enamel.
(b) For brush or spray; air dry.
(c) Decorative, protective; King enamel for gas engines, steam engines, presses, machine tools, dynamos, etc.; No. 6132 for woodworking and metalworking machinery.

Horn Co., A. C., Horn Bldg., Long Island City 1, N. Y.
(a) Custom-made finish; paint, lacquer, enamel, varnish, etc., in any color.
(b) Brushing spraying, flow coating, dipping, etc.; air-dried, oven-baked and infra-red lamp drying.
(c) For all types of machines.

Houghton & Co., E. F., 303 W. Lehigh Ave., Philadelphia 33.
(a) HOUGHTO-BLACK black oxide finish for blackening steel parts.
(b) By immersion in 295° Fahr. salt bath.
(c) Used where corrosion resistance is required, for war material, industrial machines, etc.

I, K, L

Indium Corp. of America, 1676 Lincoln Ave. Utica, N. Y.
(a) INDIFUSED Indium, silver luster finish.
(b) Plating and diffusion.
(c) Wear and corrosion resistant, decorative and functional; for nonferrous metals, etc.
See advertisement, Page 238

Irvin, Jewell & Vinson Co., 17 E. Third St., Dayton, O.
(a) ANCO plastic paste form paint in special colors and white.
(b) For spraying, rubbing in, etc.; air dried, infra-red light dried, low heat.
(c) For use in filling indentations in plastic parts such as auto dials, refrigerators, etc.

Krome-Alume Inc., 241 Bewley Bldg., Lockport, N. Y.
(a) KROME-ALUME plated aluminum finish.
(b) Plating.
(c) For plating aluminum with nickel and chromium for decorative purposes; with nickel and chromium for wear resistance in machine parts; with brass for rubber adhesion; with copper for soldering by ordinary means and with such corrosion-resistant metals as cadmium, zinc, etc.

Lawrence & Co., W. W., 1124 West Carson St., Pittsburgh 19.
(a) Paint, lacquer enamel, etc., in standard colors.
(b) Applied by spraying, brushing flow coating, dipping, etc.; for air drying, baking, etc.
(c) For all types of machines.

Liquid Plastic Div., Ferro Enamel Corp., 4150 E. 56th St., Cleveland.
(a) VEDOC organic paints in all colors to meet government specifications, or individually compounded. Also, VEDOC synthetic finish, available in colors.
(b) For spraying and dipping; baked.
(c) Decorative and protective; VEDOC organic finish for trucks, shells, mines, etc. VEDOC synthetic for washing machines, refrigerators, etc.

Long Jr. Co., Charles R., 1630-1644 W. Hill St., Louisville, Ky.
(a) STABRITE machine enamel in any color; also STABRITE wrinkle finish in any color except white.
(b) Machine enamel for brush, spray, flow or dip; air dry or bake. Wrinkle finish for spraying only, and baking.
(c) Protective and decorative, for either outer or inner surfaces of any type of machine. Wrinkle finish used where baking permissible.

Lowe Brothers Co., 424 E. Third St., Dayton F-2.
(a) LOWE enamel or lacquer finish, in standard machine tool gray and other shades.
(b) Brushed, but usually sprayed; air-dried.
(c) Decorative and rustproofing; for machine tools and miscellaneous machinery.

M

Maas & Waldstein Co., 438 Riverside Ave., Newark, N. J.
(a) METALUSTRE lacquer enamels and synthetic enamels available in 28 standard colors; RAYDUR synthetic enamels in most colors; DUART WRINKLE enamels in most colors; CODUR enamels in colors; and DYKAST lacquer enamels in most colors.
(b) Metalustre, spray, air dry and bake; Raydur, spray or dip, bake (Infra-red) ovens; Duart, spray; Codur, spray or dip; and Dykast, spray and dip, air dry.
(c) Decorative and protective coatings; Metalustre is used for sheet metal work and castings; Raydur on any machine requiring a tough, durable finish; Duart for cabinets and metal or Bakelite parts that can be baked; Codur for any type of machine requiring moisture and chemical resistant finish; and Dykast for zinc and aluminum die castings.

McDougall-Butler Co. Inc., Buffalo, N. Y.
(a) HARDCOTE synthetic finishes in many color combinations; also varnishes, enamels, and paints.
(b) Brush, spray or dropper method; and dries dust-free in 15 min.; hard in one hour.
(c) For inside or outside surfaces of wood, metal or plastics; corrosion resistant.

Merkin Paint Co. Inc., M. J., 1441 Broadway, New York, 18, N. Y.
(a) MERKIN industrial enamel in colors.
(b) For brushing or spraying; air dried.
(c) For protective and decorative purposes on any machine where durability and "light-for-seeing" are factors.

Mitchell-Bradford Chemical Co., 2446 Main St., Bridgeport, Conn.
(a) BLACK-MAGIC, DIE-CAST BLACK and WITCH DIP, blackening salt for steel, iron, copper and zinc. Also SILCO vitreous coating, in dull finish which may be buffed to egg-shell gloss, as well as black, Army drab and Navy gray.
(b) BLACK-MAGIC, DIE-CAST BLACK and WITCH DIP for dipping, self-drying. SILCO for spraying; baking and infra-red drying.
(c) BLACK-MAGIC, DIE-CAST BLACK and WITCH DIP is decorative and rustproofing; for fabricated steel and wire parts, screw machine parts, small arms, etc. SILCO is for engine exhaust manifolds, mufflers, etc.

Monsanto Chemical Co., Merrimac Division, Everett Sta., Boston 49.
(a) MONSANTO lacquers and enamels, and lacquer-enamel, in all standard colors.
(b) All sprayed or dipped; lacquer-enamel and lacquer air-dried; enamel is air-dried and baked.
(c) Protective, decorative coating; for all types of machines.
See advertisement, Page 227

N

New Jersey Lacquer Co. Inc., 4400 Dell Ave., North Bergen, N. J.
(a) PYROLAC lacquers, synthetic coatings; available in all colors.
(b) For spray, dip, brush; air dry and bake.
(c) Decorative, heat resistant, rustproofing; for cinema projectors, cameras, typewriters, scales, electric instruments, navigation instruments, sound detection devices, etc.

New Wrinkle Inc., Dayton, O.
(a) WRINKLE enamel in all colors.
(b) Applied by spraying; oven or Infra-red dried.
(c) Decorative and protective; for all types of machines.
See advertisement, Page 234

Nikolas & Co., G. J., 1227-1235 Van Buren St., Chicago. (also 33 Grand St., Brooklyn, N. Y.)
(a) NIK-O-LAC lacquer in all colors.
(b) For brushing, spraying and dipping; air drying.

(c) For decorative and heat-resistant purposes for all types of machines.

O, P

Ohio Bronze Powder Co., 1120 E. 152nd St., Cleveland.
(a) LUXRITE bronze powders, in silver, gold, copper and other shades.
(b) Plating, spraying or dipping; air drying.
(c) Rustproofing, heat resisting and decorating; on agricultural and other types of machinery.

O'Neil Duro Co., 2156 S. Fourth St., Milwaukee.
(a) DURO lacquer and enamel in gray or any color.
(b) For brush, spray or dip; for baking, air drying or infra-red radiation.
(c) Decorative, rustproofing, heat resisting, etc.

Parker Rust-Proof Co., 2177 East Milwaukee Ave., Detroit.
(a) PARKERIZING, BONDERIZING and PARCO LUBRIZING.
(b) Spray or dip; force drying.
(c) Rustproofing and as a base for paint, lacquer, enamel and oil finishes; also PARCO LUBRIZING for bearing surfaces to prevent scuffing.

Peninsular Paint & Varnish Co., 8250 St. Aubin Ave., Detroit.
(a) KLEEN-EZY and PENPROX, paint, varnish, enamel and lacquer; in all colors.
(b) For brush, spray or dip; air drying or baking.
(c) Decorative, rustproofing, heat resisting, etc.; for all types of machinery.

Pittsburgh Plate Glass Co., Industrial Paint Div., Grant Bldg., Pittsburgh.
(a) Pittsburgh industrial finishes; paints, varnishes, lacquers and special process finishes to manufacturers specifications.
(b) Suitable for all methods of application.
(c) Decorative and protective finishes for all types of machines.

Porcelain Enamel & Mfg. Co., Eastern & Pemco Ave., Baltimore.
(a) PEMCO porcelain enamels. Glazes in any color.
(b) For spray and dip; continuous dryer.
(c) Decorative and rustproofing; for all types of machines.

Porcelain Metals Inc., 28-20 Borden Ave., Long Island City, N. Y.
(a) SUPORCEL porcelain enamel, all colors and textures.
(b) For spraying; hot air, then firing at 1550 degrees Fahr.
(c) Decorative, where sanitation, permanency of finish and easy cleaning is required.

Pratt & Lambert Inc., 75 Tonawanda St., Buffalo 7.
(a) P & L Machine tool enamel and other enamels, paints, lacquers, varnishes, etc.; in any color.
(b) Brush, spray, flow, dip; air-dried and baked.
(c) Decorative and protective; for all types of machines.

Pyrene Mfg. Co., 560 Belmont Ave., Newark, 8 N. J.
(a) UDYLITE, cadmium finish, in silvery-white; BRIGHT ZINC in silvery white; PYRENE BRIGHT NICKEL, thick deposits of high brilliance; BONDERITE, in gray paint base; CHROMIUM; ALUMILITE; PARKERIZING, silvery to variety of black finishes. ANODIZING by Alumilite process for protection and finishing of aluminum and its alloys.
(b) Udylite, Bright Zinc, Bright Nickel and Chromium plating; Bonderite, Parkerizing immersion; Alumilite, electrolytic; Parkerizing chemical displacement without changing dimensions or physical characteristics.
(c) Rustproofing, decoration, as base for plating, or for wear resistance.

Q, R

Quigley Co. Inc., 56 W. 45th St., New York.
(a) TRIPLE-A industrial enamels in maroon, green, red, orange, gray, blue, buff, yellow, black, white, and aluminum.
(b) For brushing and spraying; dries by evaporation.
(c) Protective, waterproofing coating used on wide range of machinery and equipment.

Reilly Tar & Chemical Corp., 1615 Merchants Bank Bldg., Indianapolis.
(a) RESISCOTE paint, in gray, etc.
(b) Brush or spray; air dried or baked.
(c) Rustproofing, protection against corrosive gases, etc.; for all types of machines.

Roxalin Flexible Lacquer Co., 806 Magnolia Ave., Elizabeth, N. J.
(a) ROXAPRENE synthetic enamel, in all colors; RINCONTROL wrinkle enamel, in practically all colors.
(b) For spraying and dipping; Rincontrol only for spraying.
(c) Both are decorative and corrosion resistant; Roxaprene used for air conditioning equipment, etc.; Rincontrol used for business and electrical appliances.

Ruberoid Co., 500 Fifth Ave., New York.
(a) RUBEROID rapid asphalt paint, in black only.
(b) For spraying and dipping.
(c) Rustproofing, resistance to high temperature, acid fumes, etc.; for cables, tubing, tanks, battery boxes, etc.

S

Seaporcel Corp., 28-20 Borden Ave., Long Island City, N. Y.
(a) SEAPORCEL ceramic finish; in all colors.
(b) For spraying; hot air, then firing at 1550 degrees Fahr.
(c) Tenacious, will not chip unless base metal is fractured, will not corrode, heat-resisting, permanence of finish, ease of cleaning.

Seidlitz Paint & Varnish Co., 18th and Garfield Ave., Kansas City, Mo.
(a) SEIDLITZ wrinkle finishes, synthetic enamels and primers, in snow white, black and all colors.
(b) For brushing, spraying or dipping; air dry or bake.
(c) Decorative and protective; for all kinds of machinery.

Sherwin-Williams Co., 101 Prospect Ave., Cleveland.
(a) Sherwin-Williams enamels; also paints, varnishes and lacquers to suit individual requirements, and heat resistant finishes.
(b) Brush or spray; air drying or baking.
(c) For application to all types of machines. Enamels save finishing time; are durable.
See advertisement, Pages 138, 139

Simoniz Co., 2100 Indiana Ave., Chicago.
(a) COROL semi-hard removable anticorrosive.
(b) For spray, dip, brush; air dried, nonoxidizing.
(c) For rust and corrosion prevention on all types of machines.

Sonneborn Sons Inc., L., 88 Lexington Ave., New York.
(a) SONNEBORN'S machine and engine enamel in 14 colors, No. 3738 heat resisting gray enamel in light gray, and S.R.P. No. 75 red primer in reddish brown.
(b) Brush or spray; dry by air overnight.
(c) Machine and engine enamel is for decoration, oil-proofness, durability and withstanding heat up to about 200 degrees Fahr. No. 3738, also for decoration, and capable of withstanding heat up to about 350 degrees Fahr. Type S.R.P. No. 75 is used for rustproofing on various types of machines.

T

Thompson & Co., 1085 Allegheny Ave., Oakmont, Pa.
(a) RABAKE enamel (infra-red bake), in white, gray and green. GRAY METALLIC dull aluminum finish. Also, Photo Finish lacquer in all colors, flat finish for plastics.
(b) RABAKE and GRAY METALLIC sprayed and baked for short period. Photo Finish is sprayed and air-dried.
(c) RABAKE for heat resistance and marproofness of light gage housings. GRAY METALLIC finish is decorative. Photo Finish is lusterless, and adhesive to most molded plastics.

Thurmalox Co., Doylestown, Pa.
(a) THUR-MA-LOX finish in gray, green, white, black and aluminum.
(b) For spraying and brushing.
(c) Heat resisting on hot metal surfaces.

Triskalite Corp., 67 Wall St., New York.
(a) TRISKALITE white chromium-like deposits.
(b) Electroplating; hot-air, hot-water evaporation.
(c) Decorative and rustproofing.

Tropical Paint & Oil Co., 1276 West 70th St., Cleveland.
(a) TROPELITE varnish (100 per cent Bakelite), available in clear, black and gray; A.C.B. primer and finishing coats in red, gray, and black.
(b) Tropelite can be applied by any method and is air dried; A.C.B. by brush or spray, also air dried.
(c) Tropelite is alkali, acid and moistureproof and A.C.B. is a rustproofing and decorative coating; both can be used on all kinds of machinery.

Truscon Laboratories Inc., Caniff & G.T.R., Detroit.
(a) SPEEDREX enamel paint, in standard machine tool gray and other colors to order.
(b) Spraying, dipping or brushing; air-dry or force-dry.
(c) Rustproofing, decorative, low heat resistance; for machine tools or machines used on outside work such as concrete road spreaders, etc. Chemical and weather-resistant.

U, V, W, Z

United Chromium Inc., 51 E. 42nd St., New York.
(a) UNICHROME alkaline copper plating. UNICHROME air dry coating in light gray and UCILON lacquer in white, black, gray and green, also clear.
(b) Unichrome copper can be plated; air-dry coating applied by dipping; UCILON by brushing or dipping.
(c) The copper plating is for decorative and protectiv purposes; lacquer also is resistant to acids.

United Platers Inc., 991 Madison Ave., Detroit.
(a) UNIMATIC chrome, nickel, copper, cadmium, tin, zinc, lead, brass, bronze, stainless steel passivating, aluminum anodizing, etc., finish.
(b) Plating, dipping, tumbling, hot lead coating, parkerizing, natural and oxidized finishes.
(c) Decorative, rustproofing, wear and heat resistant; for use on all kinds of machines.

United States Stoneware Co., Akron, O.
(a) TYGON acid and corrosion-proof finishes.
(b) Spray, brush, dip or roller coat.
(c) Corrosion, oil, waterproof; develops extremely hard surface on baking.
See advertisement, Page 259

U. S. Gutta Percha Paint Co., Providence 1, R. I.
(a) RICE'S oxidized machine enamel and one coat enamel; in 12 colors, including light gray and dark machine tool gray.
(b) Brushing, spraying, dipping.
(c) Decorative, rustproofing, heat-resistant, and resistant to lubricating oils; on all types of machines, trucks, conveyors, piping and other interior equipment.

Valentine & Co. Inc., 11 E. 36th St., New York.
(a) NITRO VALSPAR lacquer, in all colors and shades; VALENITE enamel in all colors.
(b) NITRO VALSPAR for spraying or dipping; air or bake. VALENITE for spraying, brushing or dipping; air-dried or baked.
(c) Both decorative and preservative; for all types of machines.

Whitlam Mfg. Co., J. C., Wadsworth, O.
(a) VERTEX Elastic Enamel in aluminum gray.
(b) For brushing, spraying or dipping; air drying in 3 or 4 hours, or bake for 1 hour at 250 degrees Fahr.
(c) Oilproof, heat and light resistant; finish is for decorating, rustproofing, etc., on all types of machines.

Zapon Div., Atlas Powder Co., North Chicago, Ill.
(a) ZAPON QS 527 machine enamel, in all colors.
(b) Brush and spray; air dry.
(c) Decorative and protective; machine tools and other industrial machinery.

Calculating Dimensions of Segments of Circles

By William W. Johnson

EXACT formulas for the relationships between the arc, chord, radius and other characteristics of segments of circles generally contain functions of angles in such a form that direct solutions for required dimensions are not possible. Cut-and-try methods using trigonometric tables yield results to any desired degree of accuracy but are tedious and inconvenient. For the purposes of the designer an approximate solution usually furnishes sufficient accuracy and

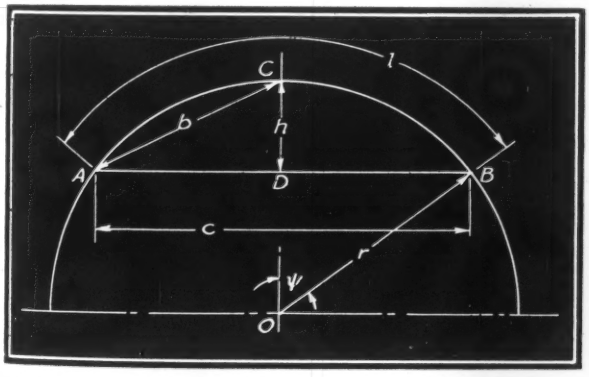


Fig. 1—Diagram defines the essential dimensions of a segment of a circle ACB

saves much time and effort. With the needs of the engineer in view the formulas presented in this data sheet have been derived. Their inherent accuracy is generally of a higher order than that of the ordinary 10-inch slide rule.

Infinite Series Is Basis

As with many other approximate formulas the procedure in deriving these relationships is to expand the function in an infinite series, taking a few terms for an approximation, or to find a fraction whose expansion will give a series agreeing with this to a few terms.

Formulas connecting the length of the arc, length of the chord, and height of the chord (*Fig.* 1) may be derived using as a basis the well-known Huygen formula which is itself an approximation derived by the method just outlined:

$$l=\frac{8b-c}{3} \qquad \ldots\ldots(1)$$

where l = length of arc, c = length of chord of whole arc, and b = length of chord of half the arc.

From *Fig.* 1 the term b may be expressed in terms of the chord length and height as follows:

$$b=\frac{1}{2}\sqrt{c^2+4h^2}$$

where h = the height of the arc. Substituting this

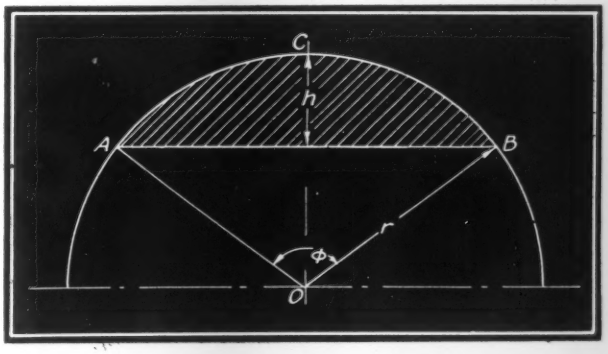


Fig. 2—Approximate formulas enable calculation of area of segment shown cross hatched, without knowledge of the central angle ϕ

value of b in Equation 1

$$l=\frac{4\sqrt{c^2+4h^2}-c}{3} \qquad \ldots\ldots(2)$$

When the length of the arc is less than one-third of

the circumference this equation is correct to three figures.

From Equation 2 two other approximate formulas can be derived as follows. Solving for h

$$h=\frac{1}{8}\sqrt{3(l-c)(3l+5c)} \quad \ldots\ldots (3)$$

Solving for c

$$c=\frac{3l+4\sqrt{9l^2-60h^2}}{15} \quad \ldots\ldots (4)$$

Equations 3 and 4 give accurate results when the length of arc and the length of chord are nearly equal, the height of the arc being small. To find the length of the chord by exact formulas necessitates the use of trigonometric tables.

Radius Is Found

By similar methods approximate formulas can be derived for finding the radius when the chord and length of arc are given. From *Fig.* 1 it is evident that $c = 2r \sin \psi$ where ψ = one-half the central angle $= \sin^{-1}(l/2r)$. Hence $c = 2r \sin^{-1}(l/2r)$. This is an exact equation but it is evident that it is impossible to solve directly for r. However, by expanding the right-hand member into a series and discarding all but the first few terms the following approximate equation is obtained:

$$r=l\sqrt{\frac{1}{24\left(1-\frac{c}{l}\right)}-\frac{1}{80}-\frac{11}{5600}\left(1-\frac{c}{l}\right)} \quad \ldots\ldots (5)$$

This equation gives close results even in the extreme case when the length of arc is a semicircle.

Yields Accurate Results

When the chord is nearly equal to the length of the arc, the formula may be shortened to

$$r=l\sqrt{\frac{1}{24\left(1-\frac{c}{l}\right)}-\frac{1}{80}} \quad \ldots\ldots (6)$$

EXAMPLE: It is required to find the radius of the circle in which a 30-foot chord subtends a 32-foot arc. Substituting the values $l = 32$ and $c = 30$ in Equation 6, the radius is found to be equal to 25.88178. Using the exact equation which must be solved by the method of successive approximation, it is found that $r = 25.87933$ feet. Although the central angle in this case is more than 70 degrees the accuracy is remarkable.

Determining Area

Area of the segment of a circle indicated by cross hatching in *Fig.* 2 is given by the exact formula

$$A=\frac{r^2}{2}(\phi-\sin\phi) \quad \ldots\ldots (7)$$

where r is the radius and ϕ is the central angle.

A more useful expression results if the central angle ϕ is eliminated and the area expressed in terms of the radius and height of the arc or the chord length and height of the arc. Such a formula is derived from *Fig.* 2 using the relation

$$h=r-r\cos\frac{\phi}{2}=2r\ \sin^2\frac{\phi}{4}$$

which may be written

$$\sin\frac{\phi}{4}=\sqrt{\frac{h}{2r}}$$

Using this relation to eliminate the central angle ϕ from Equation 7 there results an expression which can be expanded into an infinite series. Discarding all but the first few terms and effecting some transformations, the following approximate formula results:

$$A=\frac{4h^2}{3}\sqrt{\frac{2r}{h}-.608} \quad \ldots\ldots (8)$$

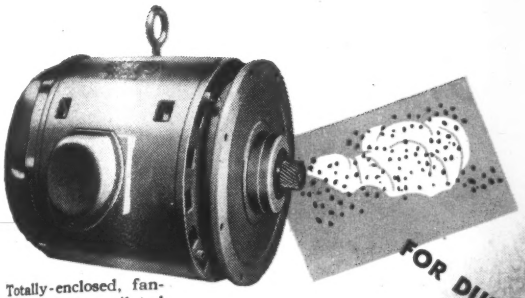
The value .608 is found by trial so as to make the formula exact for angles near the middle of the range for which the formula would be likely to be used.

When the chord $AB = c$ is given instead of the radius r, another approximate formula is obtained:

$$A=\frac{2}{3}h\sqrt{c^2+1.568h^2} \quad \ldots\ldots (9)$$

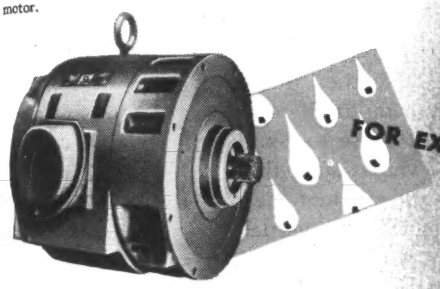
The value of approximate formulas is becoming more and more recognized in engineering practice. Time and effort are conserved while the possibility of error is reduced due to the simplicity of the approximate relation compared with the exact formula.

Post-war conversion?



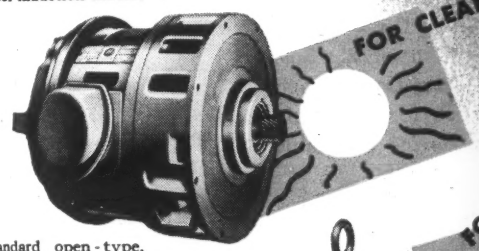
Totally-enclosed, fan-cooled, dual-ventilated motor.

FOR DUSTY LOCATIONS



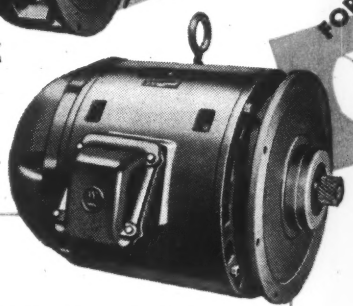
Splashproof, weather-proof induction motor.

FOR EXPOSED LOCATIONS



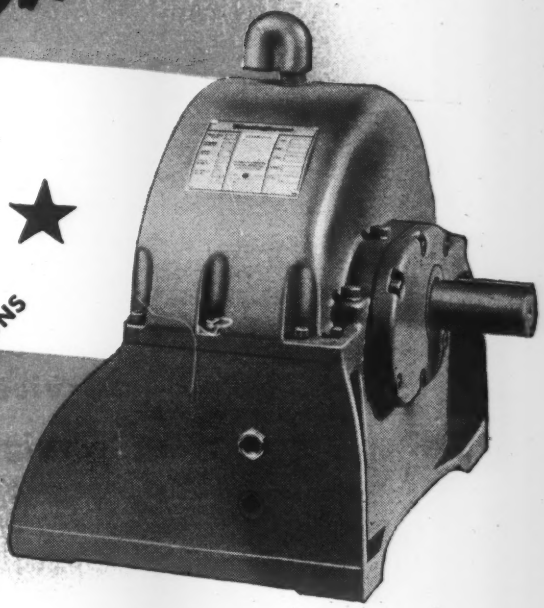
Standard open-type, squirrel-cage induction motor.

FOR CLEAN, DRY LOCATIONS



Explosion-proof induction motor.

FOR HAZARDOUS LOCATIONS



THIS GEARMOTOR IS DESIGNED FOR IT!

Your postwar conversion may mean shifting motors and machines to new locations. New locations may require different type motors—open, totally-enclosed, splashproof or explosion-proof. But whatever your postwar need, the versatile new line of Westinghouse Gearmotors is designed to meet it. Standard Westinghouse motors of all types in the installed frame size are *interchangeable* on the gear frame.

This complete interchangeability of motor types means *flexible* slow-speed drives that can be modified when conditions change—easily, economically and quickly.

There is a multitude of additional design features in the new Westinghouse Gearmotor. It is available in ratings from 1 to 75 hp with standard AGMA output speeds. For complete information, write for new application Bulletin 3218, a 20-page handbook of gearmotor applications. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., Dept. 7-N. J-07214

IMPROVED FOUNDATION STABILITY

Feet for all new Westinghouse Gearmotors are under the gear case . . . placing support next to gearmotor load. External ribs reinforce *each* gearmotor foot.

FLUSH MOUNTING SAVES SPACE

New Westinghouse Gearmotors are extremely compact. No part of the gear housing projects beyond the line of the mounting feet. This permits fitting gearmotor tightly against driven machine.

MEETS STANDARD CLASSES OF SERVICE

New Westinghouse Gearmotors are designed to meet AGMA Standard Application Practice . . . making it easy to order and match gearmotors to *any* job.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

GEARMOTORS

☆ Buy War Bonds & Stamps ☆

...they meet the rigid Specifications of the

ARMY-NAVY-MARITIME

Designed and Engineered for Shipboard Service above and below deck... both for Combat and Merchant Service.

Baldor Motors meet the high standards of Industry also ... so they will surely meet your requirements.

The 100% Protected Motor with liberal overload capacity

BALDOR ELECTRIC COMPANY, ST. LOUIS
District Offices in Principal Cities

BALDOR
BETTER MOTORS

PROFESSIONAL VIEWPOINTS

". . . extends nomogram use"

The network nomogram, *Fig.* 1, extends the usual three-variable nomogram to one of five variables, and yet uses only one computing secant. The three logarithmic scales *A*, *C* and *B* are so constructed that a secant across them cuts out values such that $C=AB$; but as multiplying *A* or *B* by a constant means merely sliding all of its graduations up or down equally, *E* may be used for the constant for *A*, and *D* for *B*. The new secant then gives the product of four variables, such as $C=AEDB$, or with concrete values $48 = 4 \times 2 \times 3 \times 2$. The scales *A* and *B* must have the same modulus *m*; and scale *C* midway between them, $m/2$. Scale *A* is not graduated (visibly), but its extremities are marked 1 and 10. Scale *B* graduations serve for those of the net at the right, which is merely a device to enable the raising of the graduations

Fig. 2

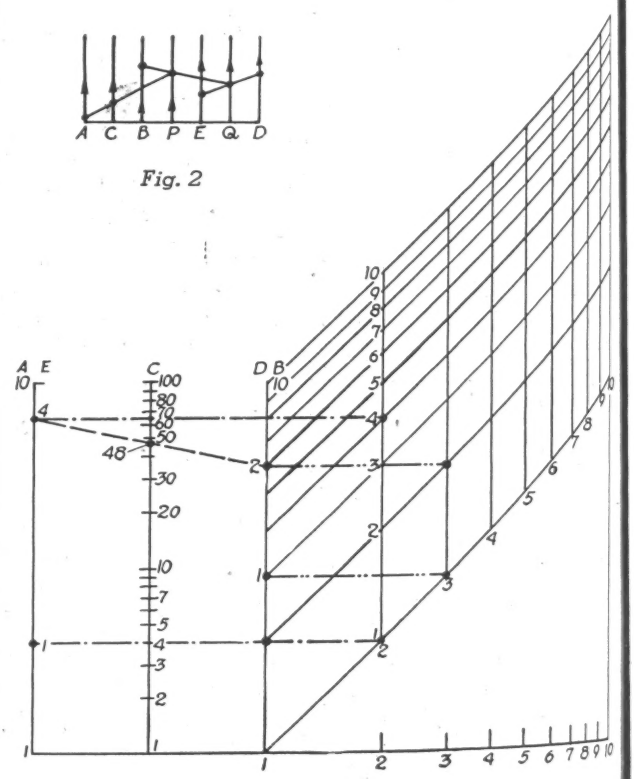
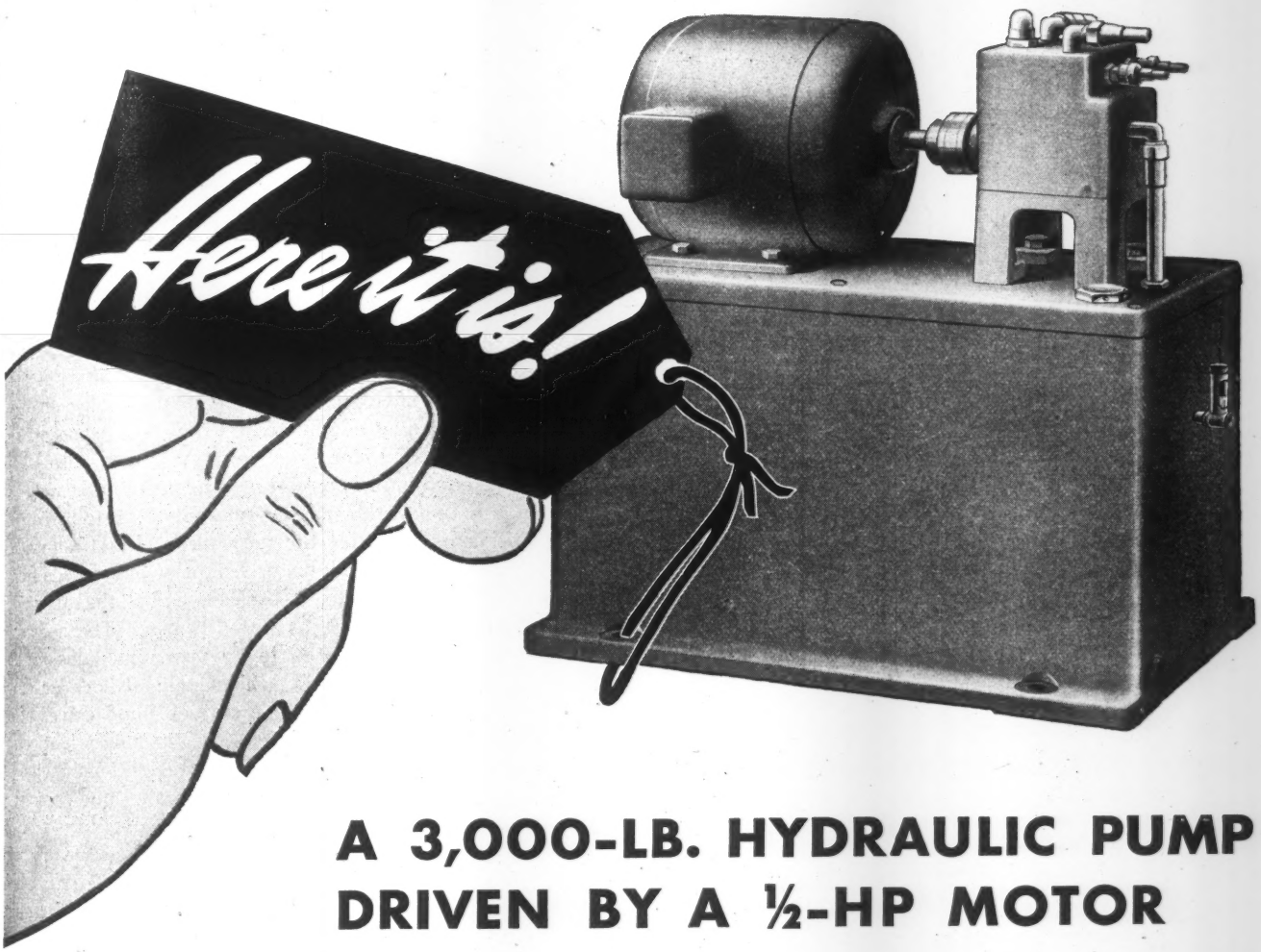


Fig. 1

on the scales *A* or *B* by one of the factors and for marking the raised graduation with another factor.

Thus scale *E* is raised so that 1 on it is at 2 on *A*. Then all values on *E* are those on *A* multiplied by 2; and 4 on *E*, projected from the network, represents the product *AE* or $2 \times 4 = 8$. Similarly, 1 on *B* is raised to 3 on *D*; and 2 on the raised scale then represents $2 \times 3 = 6$. The sin-

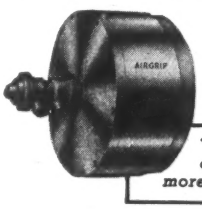


A 3,000-LB. HYDRAULIC PUMP DRIVEN BY A ½-HP MOTOR

HERE is the new 3,000-lb. Hi-Po Supercharged Hydraulic Pump—driven by a ½-hp. motor—delivers power free from pulsations—builds up pressure fast—available in a range of sizes adaptable to the operation of machine tools, hydraulic cylinders used in the plastic arts, hydraulic cylinders for die casting, and many other hydraulic power applications.

This supercharged pump has a low-pressure section which supercharges a high-pressure section. The entire unit is compact, and all parts are easily accessible. All materials are carefully selected to give long unfailing service.

Anker-Holth engineers are ready to help you with your hydraulic power problems, and to show you the numerous advantages of the new Hi-Po Supercharged Pump.



"Airgrip" revolving air cylinders assure more efficient operation.

Anker-Holth engineers also are ready to help you *increase production more than 25%, reduce operator fatigue, and lower machining costs* by the application of "Airgrip" high speed revolving air cylinders and "Airgrip" air operated chucks. Write for the new "Airgrip" catalog!

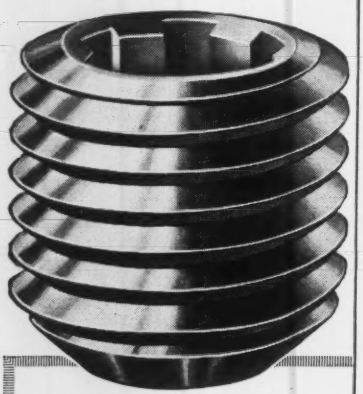
Anker-Holth Mfg. Co.

Hydraulic Division

332 S. Michigan Ave. Chicago 4, Ill.

LEADING
COMMUNICATIONS EQUIPMENT
FIRMS ARE SPECIFYING

BRISTO MULTIPLE-SPLINE SOCKET SET SCREWS



SET FASTER
SET EASIER
SET TIGHTER
For FAST ASSEMBLY of Small Parts

SPECIFIED TODAY by leading manufacturers of aircraft parts, aerial photographic equipment, and electrical communications equipment.

Many sub-contractors are finding "Bristo" written into specifications from prime war contractors. Using them, they are learning how the multiple-spline design provides greater strength, permits more tightening force even on screws as small as No. 4 wire size, and facilitates fastening at hard-to-reach points. Assembly troubles such as reamed-out sockets are eliminated, thus increasing production.

More Vibration-Proof Strength In Smaller, Metal-Saving Sizes

1 Splines, like gears, provide faster, easier transmission of rotary power.

2 Splines permit tighter setting, maximum resistance to vibration.

3 Splines "grip" wrench, permit removal without damage to socket.

See THOMAS' REGISTER for Complete Facts, List of Product Applications.

ARMY E NAVY

122 Bristol Road
Waterbury, Conn.

The BRISTOL Company
MILL SUPPLY DIVISION

gle secant drawn connecting the raised marks, 4 and 2 thus found, cuts scale C at 48 or 8 x 6.

The nomogram uses only two points on two scales as projected from the net. It solves a problem like this: A block of metal measures 2 inches (E) x 3 inches (D) x 2 inches (B). At 4 cents (A) per cubic inch what will it cost (C)?

Purposely very simple values have been taken to show the principle, but by graduating the network more completely, and ignoring the decimal point, the usefulness of the method is considerable. Incidentally, C might be affected by an exponent, and its modulus correspondingly multiplied by it. Thus, for instance, $C^2 = AEDB$, or any transformation of it, may then be solved. Scales A and B must always have the same modulus to utilize the same network, but may be affected by the same exponent. Thus $C^2 = A^{½} EDB^{½}$, for instance, may also be solved by it.

If the equation has only three quantities in the right half, then only one of the scales, preferably B, is to be raised.

The construction of the network is almost self-evident. Letting m be the modulus or height of one decade from 1 to 10, or 10 to 100, etc., of scales A and B, then the middle scale C must be $m/2$, as stated above. The network is logarithmically graduated to the same modulus m, both vertically and horizontally. The inclined lines are drawn at 45 degrees, so that the upper left-hand corner of the network is on the same horizontal as its lower right corner.

It is interesting to note that the conventional method of solving the equation by the usual parallel line nomogram, as shown in *Fig.* 2, requires seven scales, in which five would have to be completely graduated; P and Q, being turning scales, would not be graduated. On the whole, the writer believes the network method outlined requires less work.

The reader will probably discover that, if he will set off the two marks along the edge of a piece of paper and transfer them to scales A and B, the network will not be required. In such a case the spacing and moduli of the several scales need not be restricted as above, but they will have to be graduated throughout.

—CARL P. NACHOD
Nachod & U. S. Signal Co.

". . . have accomplished miracles"

To the Editor:

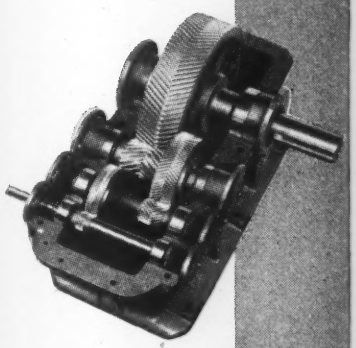
Referring to recent discussions in MACHINE DESIGN concerning standard and special machines, our industrial system and manufacturing ingenuity have traveled a long way and accomplished miracles in production, both in materials and in the application of standard machine tools to the necessary war production. Now that the machine tool industry has reached its peak, design engineers are able to utilize their abilities to adapt machines to more specialized manufacture—either by the combination of machines or by minor variations of existing designs. At the same time, the machine tool industry should be given more war orders to utilize the manpower which has been organized and trained for production.

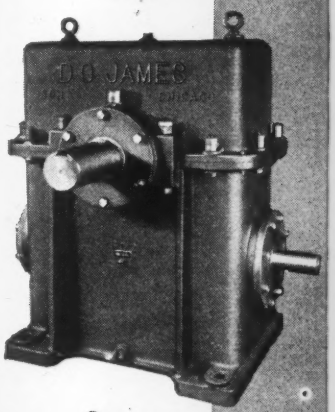
—E. D. GANGWERE
Westinghouse Electric & Mfg. Co.

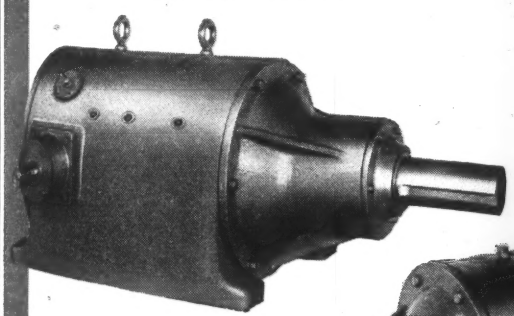
the obligations . . . and opportunities of tomorrow!

ARMY E NAVY

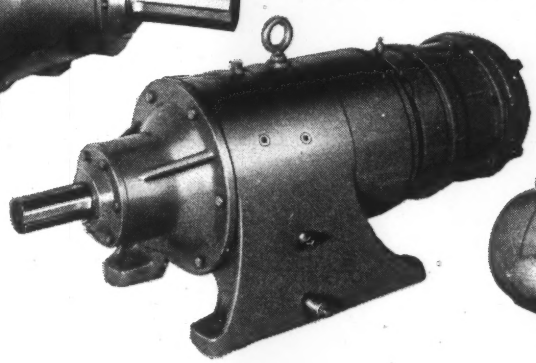
The experience derived from the successful handling of industry's vast war-time Gear and Gear Speed Reducer Requirements by our organization gives us an initiative that will prove invaluable to our capability of meeting the obligations and opportunities of industry's post-war Gear and Gear Speed Reducer Requirements.

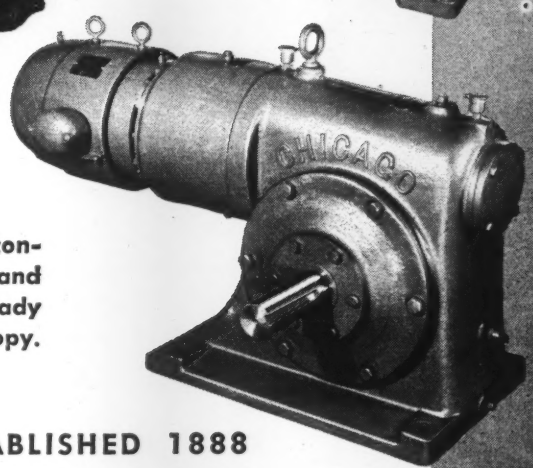






D.O.James Gear Speed Reducers are produced to meet any Power Saving Problem and are made in an extensive range of sizes and ratios.





The gear speed reducer section of Catalog 1000, containing 275 pages of engineering data, prices and illustrations of every type of reducer, is now ready for distribution. We will gladly send you your copy.

ESTABLISHED 1888

D.O.James

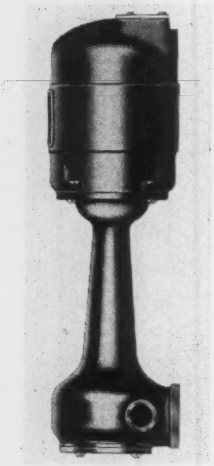
Over 55 Years Making All Types of Gears and Gear Reducers

D.O.JAMES MANUFACTURING CO.

1140 W. Monroe Street • Chicago, U. S. A.

New PARTS AND MATERIALS

Small, Sealless Coolant Pump

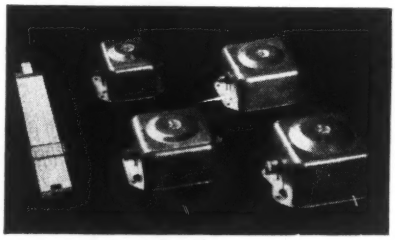


FOR providing dependable coolant flow to small machines such as hand mills, surface grinders, internal grinders, drill presses, and tapping machines, a small-sized sealless coolant pump has been offered by Pioneer Pump & Mfg. Co., Detroit. The pump is less than 16 inches high, and is claimed to be equal to that of its larger counterparts. Catalogued as Model MVBD, it is believed to be the first pump having three outlets which permit a choice of three piping arrangements—to the right, left, or back into coolant sump through intake bracket. Designed to be mounted on outside of coolant tank or machine pedestal, it functions with an extremely low water level, particularly in shallow places where coolant is out of reach for most pumps. The long-hour, single-phase, heavy-duty motors possess the same characteristics as found on the larger sizes in the line, and should not be confused with shaded-pole motors usually found on small-sized pumps.

Self-Locking Nut for Plywood

FOR use on plywood, particularly in the construction of plywood planes, a new self-locking fastening device has been introduced by Elastic Stop Nut Corp. of America, 2330 Vauxhall road, Union, N. J. All the requirements of the Army Air Corps for a self-locking fastening for plywood planes similar to the elastic stop anchor nuts used on metal planes were met by the company in this new fastening. A regular elastic stop nut, with the red cellulose locking collar, is used interlocked with a basket that locks into the plywood and holds the nut securely. Four prongs at the corner of the basket sink into the surface of the plywood, and two feet inserted in the hole are forced into the wood as the nut descends, firmly anchoring the basket. Spring fingers at top of basket clasp the nut after it is seated, and hold it firm against axial play. The nut can be driven with a hammer, forced in with a press, or drawn in with a bolt. After it has been applied, the nut is held against turning by four prongs on the corner of the washer plate and also by the feet that have been pressed into the sides of the hole. Construction makes the nut independent of the thickness of the material; it can be used on plywood from ⅛-inch up. Nut is replaceable without moving the basket, and 8/32 to 10/32 nuts are interchangeable in the same basket. The basket part is extremely light, weighing only four ounces per 100.

Aircraft Radio Noise Filters

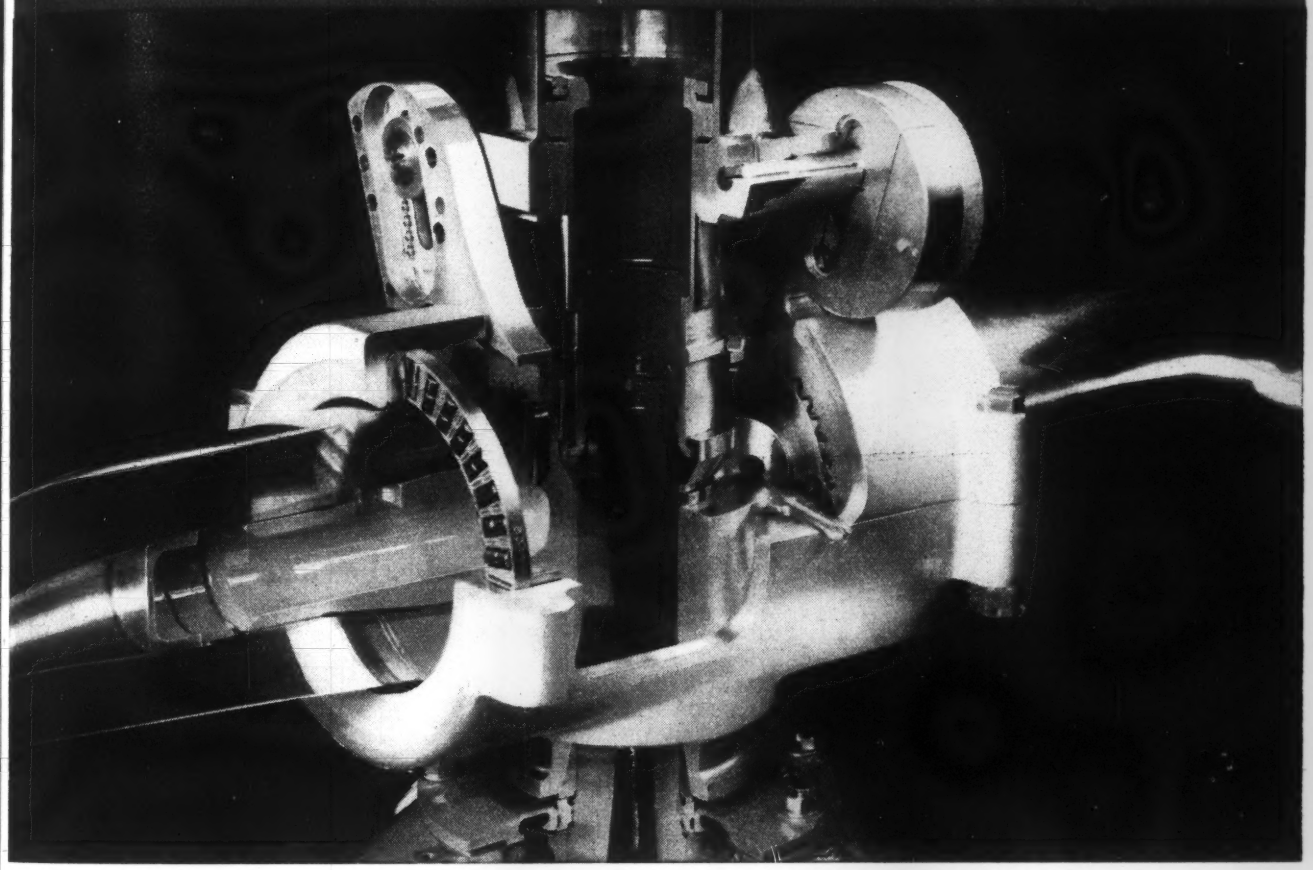


RADIO NOISE filters announced by General Electric Co. are designed to help provide the high-fidelity radio reception necessary in aerial warfare. Made available by the G. E. Company for use on aircraft electric systems—circuits with such equipment as generators, amplidynes, inverters and dynamotors—the new filters' high attenuation characteristic results in excellent noise suppression, especially from 200 to 20,000 kilocycles. The filters are available in ratings of 20, 50, 100 and 200 amperes, direct current at 50 volts, and comply with Army Air Force specifications including the requirements of vibration and acceleration. They are light in weight and compact, the 100-ampere unit weighing approximately 2 1/5 pounds and measuring 5 x 4 x 2½ inches. The filters can be mounted in any position and will operate over a temperature range of ±50 C.

Temporary Protective Coating

APPLIED by brush or dip which air-dries at a maximum of 15 minutes, depending on atmospheric conditions, a temporary protective coating has been announced by Insl-X Co., 857 Meeker avenue, Brooklyn. On a clear, dry day five minutes only is required for drying. Use of this coating eliminates greasing and other methods such as packing in pliofilm bags. When it is desired to remove the coating it is easily stripped off by hand, leaving the part clean. It can be applied equally well to rough or smooth finishes or to complicated forms,

CLOSE-UP OF A PROP'S "INNARDS"



ANOTHER VITAL JOB FOR VIM LEATHER PACKINGS

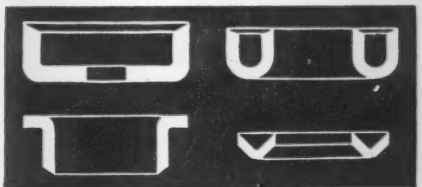
Shown above are the inner workings of a Hamilton Standard Controllable Pitch propeller—now in use on thousands of planes. By means of this hydraulically operated device, propeller pitch can be changed to give more take-off power or greater flying speed.

Sealing the inner cylinder against leakage of oil used as the hydraulic medium are VIM Leather Cup Packings—the standard for this job for many years.

Aircraft designers everywhere recognize the dependability of VIM Leather for sealing against oil, especially at low temperatures.

That's why you'll find VIM packings on jacks, shock struts, automatic pilot, windshield wiper, stand-by hand pump, pressure switch, fuel pump—all over the modern plane.

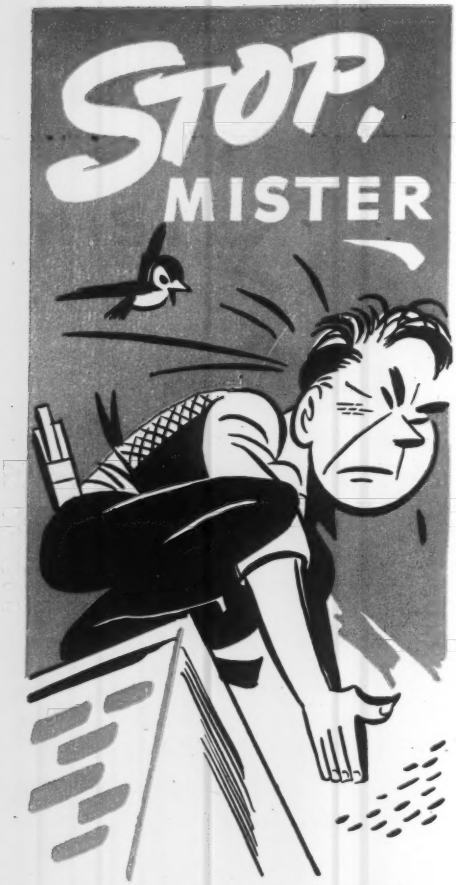
VIM Leathers of larger sizes are relied upon in larger designs, such as steel rolling mills, huge presses or operating valves. The design service rendered by Houghton engineers has contributed greatly to success of such installations. Please feel free to use it for war or post-war work. E. F. HOUGHTON & CO., Philadelphia and all principal cities.



TYPES AND USES

VIM Leather Packings are supplied in "Cup", "Flange," "U" and "V" form, also special shaped washers and gaskets. Outstanding war applications include sealing of hydraulic mechanisms in many places in modern airplanes, recoil mechanisms of guns, presses, jacks, steel mills and machine tools—for all types of hydraulic and pneumatic seals.

HOUGHTON'S *Engineered* **VIM** *Leather Packings*



...there's an easier way to end your motor problems

ask Westinghouse!

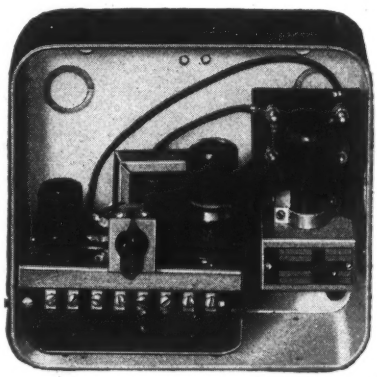
Maybe the *one best motor for your* job has to be designed . . . maybe modification or selection of an existing type will do the trick. Either way, there's no substitute for "know-how" in designing, modifying or selecting it. Westinghouse puts 57 years of motor and control experience at your disposal to get the right answer sooner. For engineering aid, phone or write your nearest Westinghouse office.

J-21288

covering all edges, etc., without danger of flowing away. Available in two forms—002 for short-term protection and 003 for long periods of storage—the temporary protective coating has withstood 100-hour, 3 per cent salt-spray tests on steel, copper, brass and aluminum without any effect.

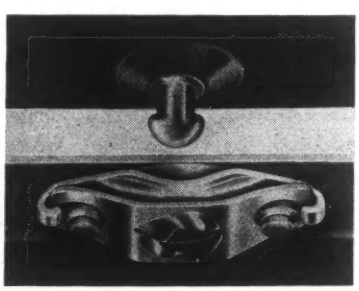
Electronic Time Relays

ADJUSTABLE electronic time relays, announced by Durakool Inc., 1010 North Main street, Elkhart, Ind., are built to control industrial processes in which extreme accuracy and long-lived performance are required. The electronic principle of operation assures freedom from trouble caused by lag or wear, and the load is carried by a quick-acting mercury relay. Fast-operating, steel-



encased plunger is the only moving part. Time settings are continuously variable within the range, and may be adjusted to precisely the required operating point. Standard models cover time ranges from .05 to .5, .1 to 10, and 1 to 100 seconds respectively. Special models can be produced up to 5 minutes. Contact capacities are available up to 75 amperes, either normally open or normally closed.

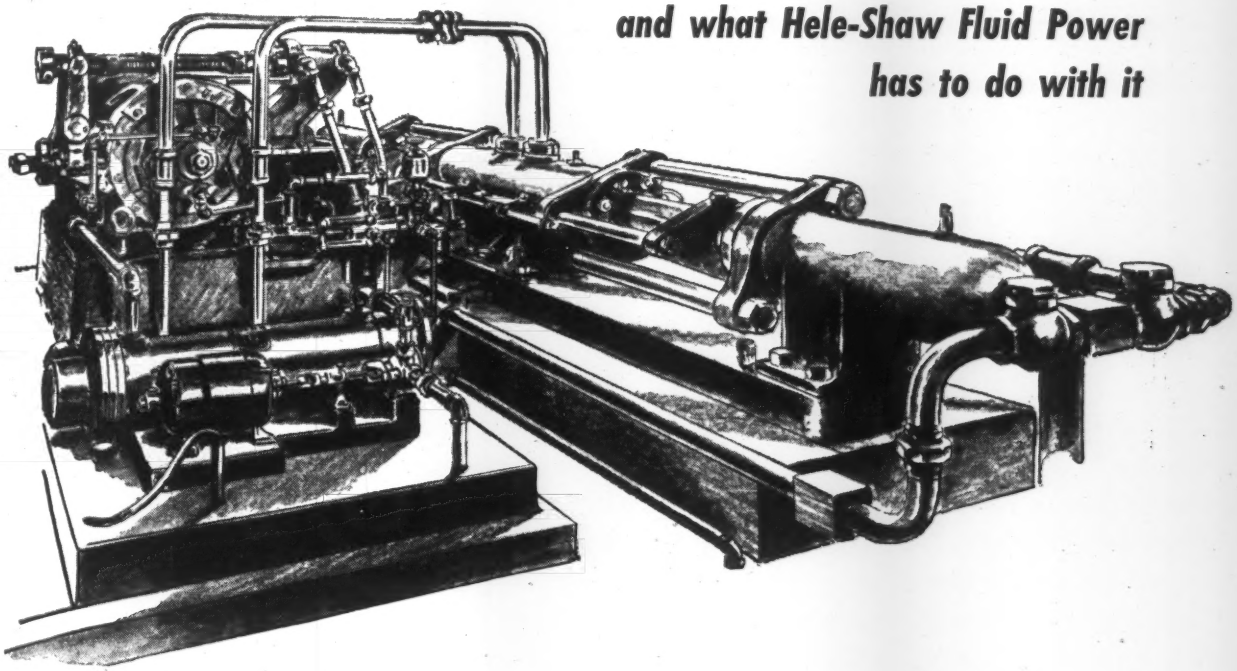
Cowl Fastener Announced



TO ALLEVIATE the shortage of cowl fasteners needed for aircraft construction, the Aero Products division of Talon, Inc., Meadville, Pa., has introduced its Lion cowl fastener which is already in production. Some of the qualities of the fastener are: Strength, compensation for misalignment, easy application, and limited sheet separation. These features were built into the fastener after a study of the requirement of the aircraft industry. The fastener at present is available in two sizes: No. 7 with 1⅜-inch rivet spacing, and No. 5 with 1-inch rivet spacing. In addition to these two sizes the company also

WHEN IS A PIPE SAFE? —

and what Hele-Shaw Fluid Power has to do with it

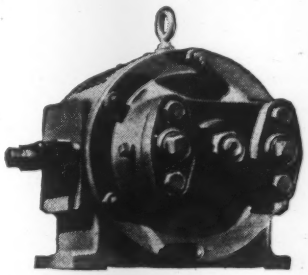


Pipes, tubes, and other high-pressure containers used to be tested by complicated arrangements of accumulators, intensifiers and valves. Often, leakage made it impossible to develop proper testing pressures. Sometimes these "one shot" devices failed to hold pressure on the first stroke and a second stroke was necessary.

One inventive mind saw a better solution, using Hele-Shaw Fluid Power (oil under pressure). Working with our engineers, he devised a tester for producing high hydrostatic pressures which applied and sustained pressures automatically and free of fluctuations. This improved pipe testing machine could be adjusted quickly over a wide range of pressures, and could be remotely controlled. There were many more advantages.

We're ready to put Hele-Shaw Fluid Power to work for you. Any post-war application concerning the improvement of a product or process, or simplification of control or operation of a machine may be appropriate for the use of Hele-Shaw Fluid Power. Hele-Shaw engineers are ready to help you find out.

THE **Hele-Shaw** *Fluid Power Pump*



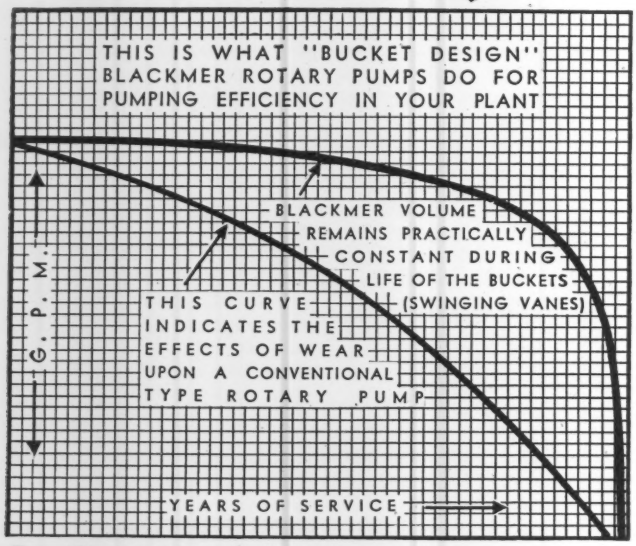
Æ CO 75th ANNIVERSARY

OTHER A-E-CO PRODUCTS: TAYLOR STOKERS, MARINE DECK AUXILIARIES, LO-HED HOISTS

AMERICAN ENGINEERING COMPANY

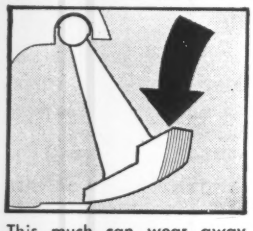
2502 ARAMINGO AVENUE • PHILADELPHIA 25, PA.

SPEAKING OF
PUMP EFFICIENCY
Here it is


THIS IS WHAT "BUCKET DESIGN" BLACKMER ROTARY PUMPS DO FOR PUMPING EFFICIENCY IN YOUR PLANT
G. P. M.
BLACKMER VOLUME REMAINS PRACTICALLY CONSTANT DURING LIFE OF THE BUCKETS (SWINGING VANES)
THIS CURVE INDICATES THE EFFECTS OF WEAR UPON A CONVENTIONAL TYPE ROTARY PUMP
YEARS OF SERVICE

The "Bucket Design" (swinging vane) principle gives Blackmer Pumps this sustained efficiency—makes them self-adjusting for wear. These sketches show you why.

Wear is confined to these points . . . the tips of the "buckets" (swinging vanes).



This much can wear away without affecting the capacity of the pump.

When finally worn out, the "buckets" are replaced (a 20-minute job) and the pump is restored to original efficiency.

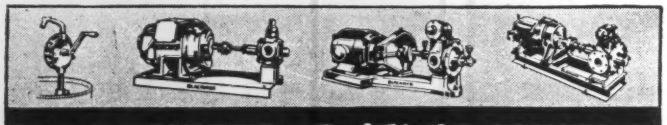
BLACKMER Nation-Wide PUMP-ENGINEERING • SERVICE •

Ready to help you solve any problem involving rotary pumps. Telephone, wire or write our plant.

Bulletins FREE to Design Engineers

No. 130: BLACKMER GENERAL CATALOG
No. 301: FACTS about ROTARY PUMPS
No. 302: PUMP ENGINEERING DATA

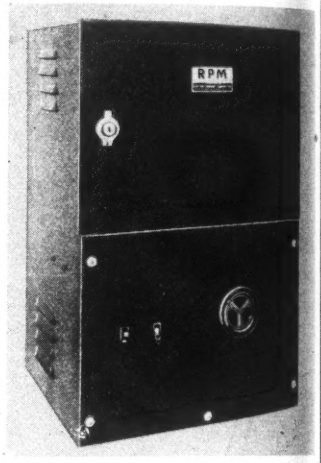
Write Blackmer Pump Company, 19710 Century Ave., Grand Rapids 9, Mich.
POWER PUMPS: 5 to 750 GPM—to 300 psi. HAND PUMPS: 7 to 25 GPM. 54 models.



BLACKMER Rotary PUMPS
"BUCKET DESIGN"—SELF-ADJUSTING FOR WEAR

will soon be producing a No. 3 size, the spring of which has a ⅝-inch rivet spacing. With the introduction of the third size the fasteners will cover the complete requirements of the aircraft industry. While at the moment these fasteners are produced for aircraft requirements only, the company expects to make the fastener usable in many other applications.

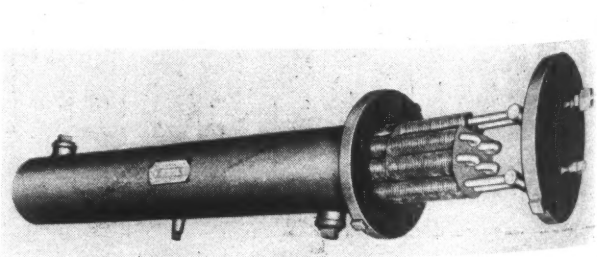
Adjustable Speed Control

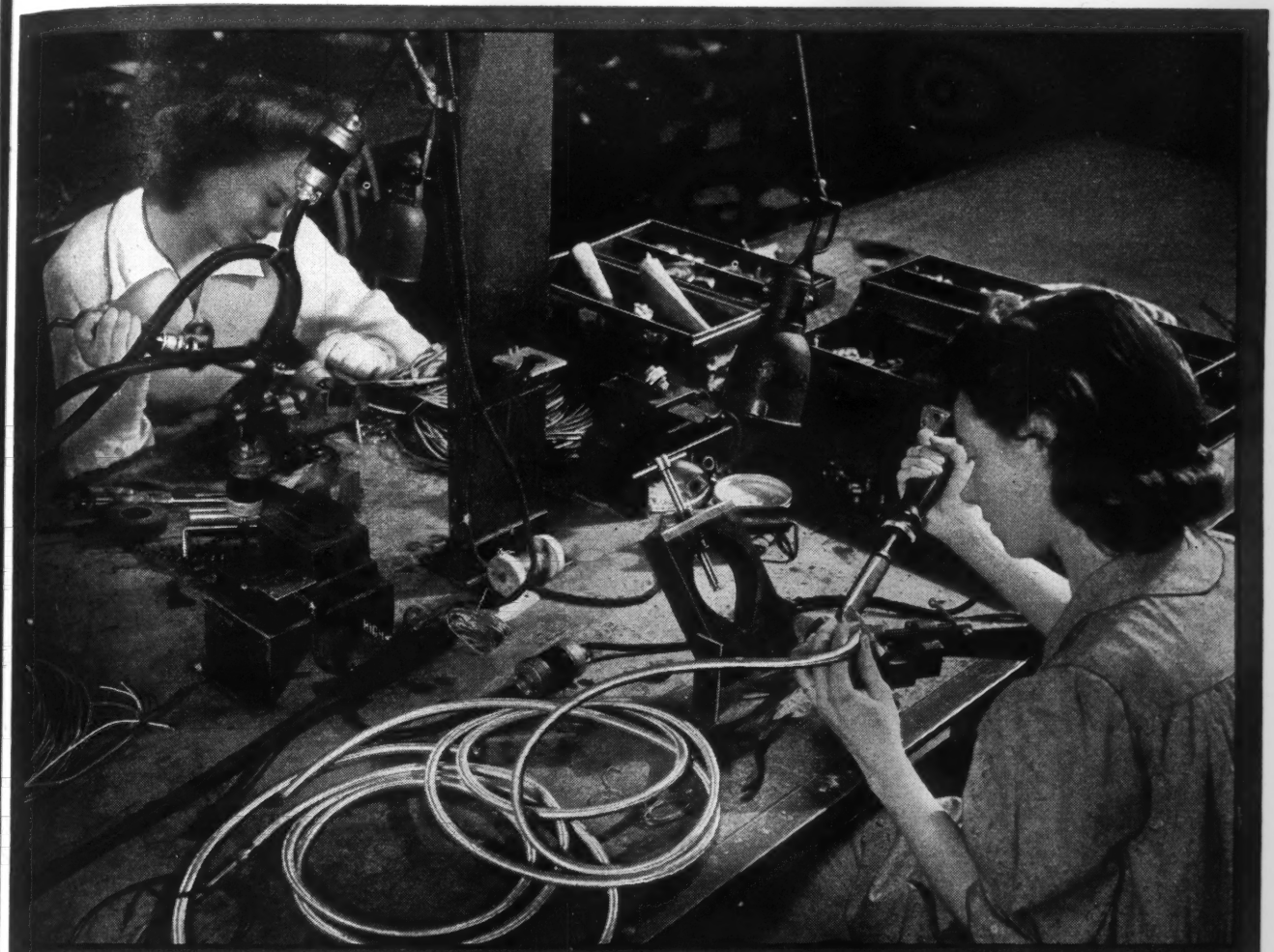


AN ADJUSTABLE speed control developed by Electron Equipment Corp., Palm Springs, Calif., has a direct drive with no gears, etc., operable on any commercial power line of 50 or 60 cycles. Speed ratio is up to 20 to 1 at constant torque, and much higher for constant horsepower applications; all stepless. Torque exerted by the motor is high, even at speeds as low as 100 revolutions per minute. Ordinary shunt-wound direct-current motor is used. Dynamic braking is available on any size if required for quick stopping. Fast, repeated and continuous reversing service as on planers has no effect on the revolutions per minute. Electron tubes in the control are of the tough, industrial type. As the waveform of the controls is not distorted at reduced speeds, no armature heating is caused by this effect, and no commutation difficulties exist. Full protection is provided to both motor and control in this rugged unit. The enclosure is of heavy steel.

Coolant Coolers Announced

DESIGN of coolant coolers announced by Kramer Trenton Co., Trenton, N. J., is based on actual tests made in accordance with standard heat transfer practice to obtain the proper ratio of primary and secondary surfaces in the cooling coil. Of the shell and fin tube type, the cooler consists of a spiral fin cooling coil inserted into a steel shell. It is provided with a bolted flanged lid for easy removal of the coil for cleaning pur-





The WIAC ...helping free men for active duty, too

When considering the important contribution that women are making towards the war effort, don't overlook the Women's Industrial Auxiliary Corps.

Like their sisters in the service auxiliaries, these women workers in practically every type of war plant are today doing many of the "tremendous trifles" so important to all-out war production.

Here, American Flexible Low-Tension Shielded Conduit is being made ready for final assembly into a medium bomber built by a prominent Eastern plane builder. Threading electrical wires through the conduit and soldering on end connections was formerly done exclusively by men. Today, however, with a minimum of training, women are doing the job equally as well, and in many cases, faster.

Flying with our bombers is only one of the important jobs assigned to American Metal Hose products. In industry, various types of American Flexible Metal Hose and Tubing convey water, gas, steam and oil; it's also used in vacuum service for removing filings and dust; as misalignment connectors or for absorbing vibration in pipe lines—to name but a few applications where these products serve with distinction.

When you have an application requiring metal hose or tubing, regardless of its nature, we invite you to "go American." For in the American line there's one than can probably help you do the job just a little bit better. Our Technical Department will gladly assist with your particular problem.

AMERICAN METAL HOSE BRANCH
OF THE AMERICAN BRASS COMPANY
General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada:
Anaconda American Brass Ltd., New Toronto, Ont.
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ANACONDA

American Metal Hose

BUY ALL THE BONDS YOU CAN AFFORD . . . TURN IN ALL THE SCRAP YOU CAN FIND

FIVE FEATURES OF THOMAS FLEXIBLE COUPLINGS

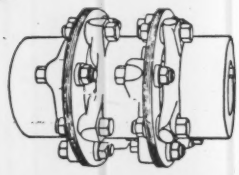
1 OPERATE UNDER MISALIGNMENT

2 NO BACKLASH

3 NO WEAR

4 NO LUBRICATION

5 FREE END FLOAT



FOR MAXIMUM EFFICIENCY OF DIESEL ENGINE DRIVES

THOMAS Flexible Couplings are the only couplings which provide all the features necessary to satisfactory performance of Diesel engine and large motor drives, where loads are subject to heavy pulsations. Send for a new Thomas catalog.

THOMAS
FLEXIBLE COUPLINGS

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNA.

poses. Coolant circulates at properly designed velocities by means of suitably spaced baffles. Units are designed for water, brine or direct expansion refrigerant. If coolant temperature is held below room temperature, lines and unit should be insulated; if above, no insulation is necessary. Shell is tested under 200 pounds per square inch pressure, the coil under 300 pounds.

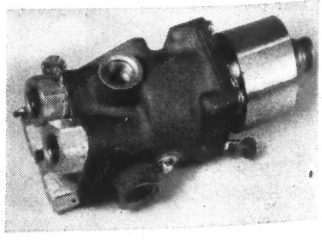
Plastic Reducing Coupling

INCREASING the applications for tubing systems made of Saran, the first reducing coupling produced of this plastic material has been developed by Commercial Plastics Co., 201 North Wells street, Chicago, completing its line of fittings. The new coupling is an adaptation of the Saran union coupling, having the same characteristics as other Saran fittings, of strength, performance, long life, etc. It is available with ⅛-inch reduction for all sizes of tubing from ¾ to ⅛-inch. Tubing and fittings made of this plastic are replacing tubing systems made of critical materials because of its chemical resistance, flexibility, toughness, fatigue life and ability to perform under unusual conditions.

Nonfraying Flexible Sleeving

EXTRA-FLEXIBLE nonfraying Fiberglas sleeving has now been made available by Bentley, Harris Mfg. Co., Conshohocken, Pa. This new super-flexible sleeving is made by an entirely new process. To prevent excessive fraying it was necessary to saturate the sleeving, sometimes to a degree where stiffness became objectionable. The new sleeving, besides being nonfraying and flexible, is heat resistant, nonflammable, water resistant, and noncrystallizing at low temperatures. The sleeving is woven from continuous-filament Fiberglas yarns, and possesses extremely high dielectric strength. All sizes, from No. 20 to ⅝-inch inclusive are available.

Reversing Hydraulic Valve



SOLENOID-operated instantaneous-reversing hydraulic valve to stop the motion of aircraft gun turrets and prevent gun coming in contact with some part of the plane has been announced by Adel Precision Products Corp., Burbank, Calif. This recently announced hydraulic valve operates automatically and stops and reverses the motion of the turret in 1/20 of a second. Developed at the request of an airplane manufacturer, the new valve originally was designed as a turret interrupter but can be used in any case where it is desired to stop and reverse

BUILT RIGHT

FOR TOP EFFICIENCY IN EVERY CYLINDER STROKE

T-J AIR AND HYDRAULIC CYLINDERS are *accurately machined* to assure *right* mounting and highly efficient performance. The mounting surfaces are parallel with (or at right angles to) the bore of the cylinder. All surfaces are strictly inspected for squareness and smoothness. All mounting holes are drilled—not just cored. T-J engineering and experienced workmanship assure *maximum power movement*...long dependability. Write for latest catalogs on T-J Cylinders. The Tomkins-Johnson Co., Jackson, Mich.

HYDRAULIC CYLINDERS. In standard capacities in eight standard styles. Two models, one for 750 lbs. pressure p.s.i. and one for 1500 lbs. p.s.i. In Cushioned and Non-Cushioned types.

AIR CYLINDERS. In all standard sizes and in seven standard styles. Cushioned and Non-Cushioned types.

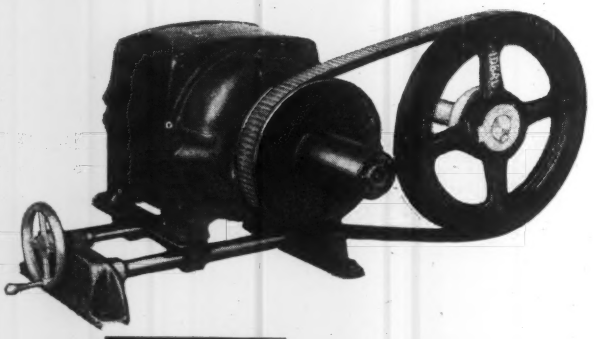
FOR TOUGH JOBS...SPECIFY T-J

TOMKINS-JOHNSON

RIVITORS...AIR AND HYDRAULIC CYLINDERS...CUTTERS...CLINCHORS

DESIGN YOUR MACHINES TO RUN Any Speed

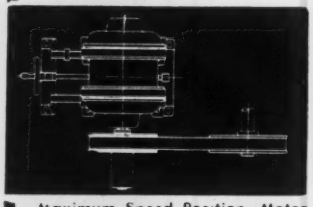
UP TO 3 TO 1 RATIO



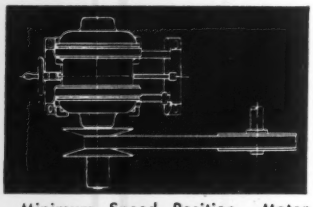
IDEAL VARIABLE SPEED

Available in V-Belt and Wide V-Belt

Speed changed at will WITHOUT STOPPING



Maximum Speed Position. Motor close to driven sheave. Pulley at largest pitch diameter.



Minimum Speed Position. Motor away from driven sheave. Pulley open to smallest pitch diameter.

WHY shackle the machines you design by limiting them to one speed? Design them to have infinitely Variable Speed (up to 3 to 1 ratio), by equipping them with inexpensive IDEAL Variable Speed. Requires no change in Basic Design. Makes machines more desirable because they are more easily adaptable to different jobs, operators, materials.

Special IDEAL Variable Speed Advantages: Minimum overhang to belt center line—curved pulley faces assure full belt contact at all driving diameters—easy to install—belt center line fixed.

FREE....

TRANSMISSION HANDBOOK

Get this 52-page book filled with new Transmission ideas—detailed data on Variable Speed Control Equipment—technical engineering information—applications—how installed. Send for your copy today.

IDEAL Sycamore

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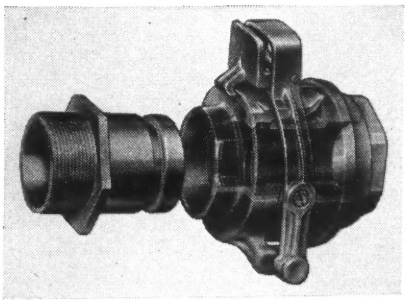
movement before a predetermined danger point. The unit operates electrically by means of a solenoid, and just before the desired "stop" position of the turret is reached an electrical circuit is closed, energizing the solenoid which tips a cam in the valve unit. Action of the cam closes the normal openings of the valve and opens the operating openings, reversing flow of hydraulic fluid and consequently the motion of the turret. When turret has moved two inches in reverse, the valve automatically returns to normal position and the turret resumes normal operation. Simple, light in weight, the valve is encased in an aluminum alloy body and weighs 3.24 pounds complete. Overall dimensions of the valve are 2¾ x 2¾ x 6 7/16 inches. Solenoid is operated on 24 volts direct current and draws approximately 15 amperes.

Quick-Disconnect Coupling

QUICK-DISCONNECT couplings for handling all fluids, including air under pressure or vacuum, offered by E. B. Wiggins Oil Tool Co., Inc., 3424 East Olympic boulevard, Los Angeles, have an instantaneous release. The industrial and marine couplings, from 2 to 10 inches in size are disengaged by releasing a latch and throwing a lever. Connection is made by placing two



ends of the coupling together and raising the lever. Couplings are made in accordance with Federal Specifications, the larger sizes being individually tested for pressure and porosity. They are available in sizes of ¾ to 2 inches, die-cast from Zamak. Larger sizes are machined from brass or aluminum. A special line of couplings includes single and double self-sealing models, as well as the open type primarily for aircraft, but also used in special marine and industrial applications.

Sump-Type Liquid Filter

UTILIZING the tested principle of radial fin construction, the new sump-type liquid filter introduced by Staynew Filter Corp., 11 Centre Park, Rochester, N. Y., is used for air, gases and liquids, or wherever dirty liquids are collected, filtered and recirculated. The new unit meets the demand for a compact, simplified filter which can be mounted on the end of pump suction lines and completely submerged in the settling basin or sump from which the pump obtains its liquid. An installation of this type protects the pump from abrasive particles which cause rapid wear and at the same time supplies clean

How to Trap Gremlins in Springs

ALL OVER BUT THE SHOOTIN'

Is Hitler washed up? We don't know. But we do know that thousands of planes, ships, tanks and bombs are pointed his way, helped by springs. And that the design of many of these springs can be facilitated by reading "Science in Springs". Your copy is now ready for you and will be mailed immediately on receiving your name on your business letter.

IN a cluster of draftees, in a barrel of apples, in a clip of shells, in a batch of springs . . . in *every* quantity made by nature or man ... there are variations from any chosen standard. What those variations are and why they occur it is often important to know. When springs run into millions, *statistical control* must be exercised to bring the largest possible portion within the desired specifications. Statistical control of springs uncovers the gremlins of quality and production, detects underlying causes for variations, controls or eliminates them, anticipates changes in quality. In the example below, a sample lot of springs was tested for load and length and readings noted. From the results a frequency curve of variations and a "skyscraper" chart were prepared. The height and location of the "Skyscrapers" show how many, and how much springs vary from given specifications. Statistical control is everyday work at Hunter, a matter-of-fact part of insuring the ONE right spring for your job.

Varied and interesting answers sented in our last advertisement those interested

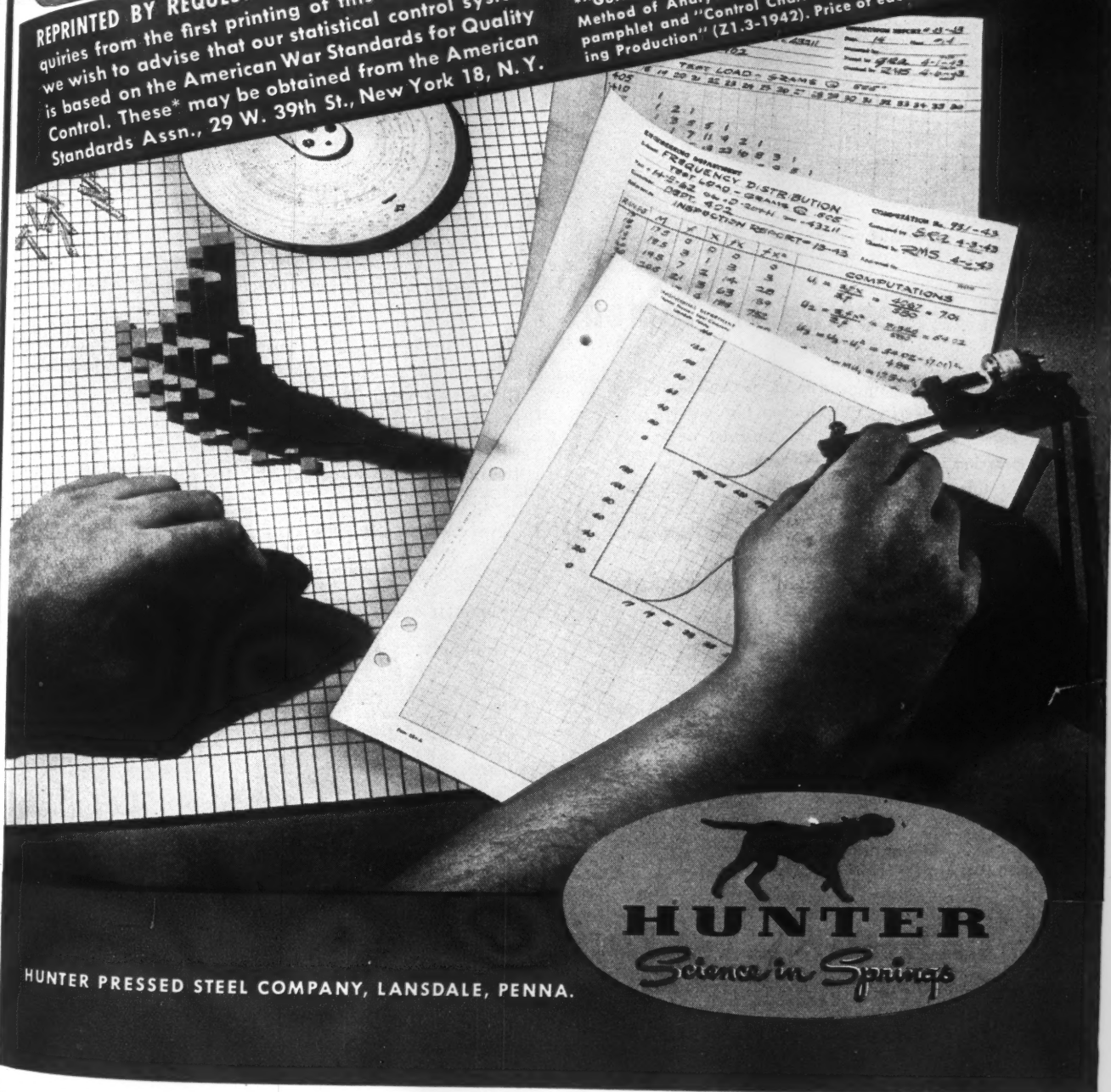
AT YOUR COMMAND

Write, wire

REPRINTED BY REQUEST—In response to many inquiries from the first printing of this advertisement, we wish to advise that our statistical control system is based on the American War Standards for Quality Control. These* may be obtained from the American Standards Assn., 29 W. 39th St., New York 18, N. Y.

Any authorized person who happens to be in our vicinity is welcome to drop in and see our system in actual operation. Hunter Pressed Steel Co., Lansdale, Pa.

*"Guide for Quality Control" (Z1.1-1941) and "Control Chart Method of Analyzing Data" (Z1.2-1941) printed together in one pamphlet and "Control Chart Method of Controlling Quality During Production" (Z1.3-1942). Price of each pamphlet is 75 cents.



HUNTER PRESSED STEEL COMPANY, LANSDALE, PENNA.

Type K Cannon Connectors are light in weight yet rugged and durable. Made in three basic types... Wall Mounting Units, Straight and 90° Cord Connectors.
CANNON CONNECTORS
...find effective use with
Vibration Testing Equipment

In this delicate scientific equipment developed and used by Consolidated Engineering Corporation for measuring acceleration, velocities and displacements, uninterrupted operation is of paramount importance.

The use of this equipment requires frequent coupling and uncoupling of fittings and Consolidated Engineers have found that Cannon Connectors save time and are uniformly dependable under all conditions.

Because of the wide variety of shapes, sizes and contact arrangements which are STANDARD with Cannon, and because of their dependability, Cannon Connectors are used in ever-increasing numbers in war and peacetime industry.

The Cannon Catalog Supplement gives data on Type K and seven other types of generally used connectors. Send us a request on your business letterhead and we will mail you a copy. Address Department A-107, Cannon Electric Development Company, Los Angeles 31, Calif.

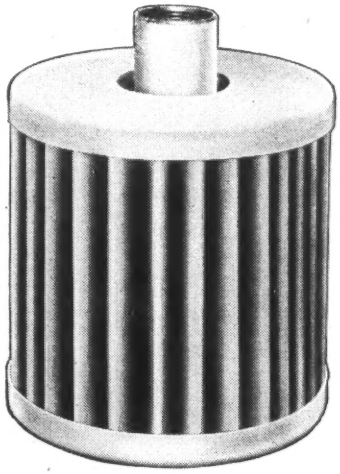
CANNON ELECTRIC

Cannon Electric Development Co., Los Angeles 31, Calif.

Canadian Factory and Engineering Office:
Cannon Electric Co., Ltd., Toronto, Canada

Representatives in principal cities—consult your local telephone book

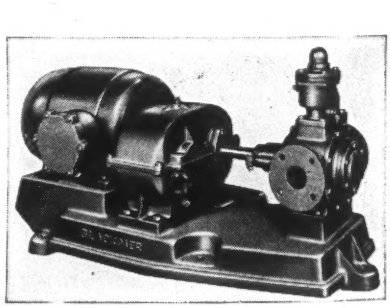
liquid at various points of usage. Providing a maximum of effective filtering area in a minimum of space, there is less resistance to flow. Simplicity of construction permits dismantling of unit without removing it from pump suction line. It consists of four major parts: An upper



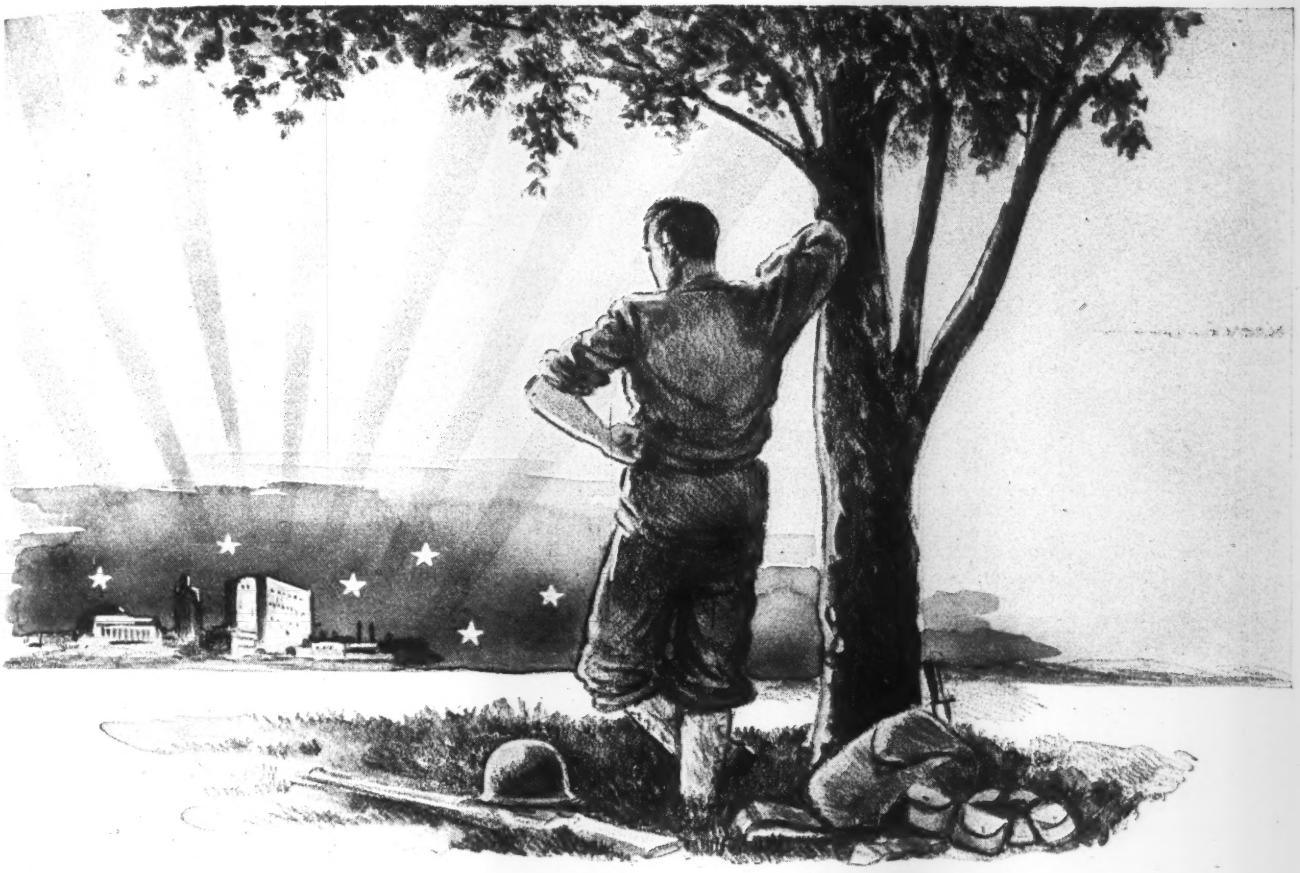
end plate mounting a threaded sleeve outlet connection and a perforated metal central supporting tube on which is mounted the filter insert; a heavy corrugated metal screen to supply strength and rigidity, over which slides the preformed filter insert; a lower end plate. A wing nut holds the entire assembly together.

Antifriction-Bearing Pump Announced

FOR general industrial use a new series of rotary pumps with antifriction bearings has been made available by Blackmer Pump Co., Grand Rapids 9, Mich. This series of pumps was described in the September issue of MACHINE DESIGN, but a wrong cut was used with the announcement. Capacities of the pumps range from 10



gallons to as high as 750 gallons per minute, at pressures up to 150 pounds per square inch. The antifriction bearing design has the advantage of reducing power requirements and permitting higher operating pressures. As bearings are in contact with the liquid pumped, the new units are recommended only for handling viscous liquids, or nonviscous liquids having lubricating properties such as oils, molasses, syrups, etc. The pumps are available in all-iron or in bronze-fitted construction, with or less removable liners; also with steam-jacketed heads and in all standard drives including gearhead motor.



NOT "DER TAG" BUT "THE DAY"

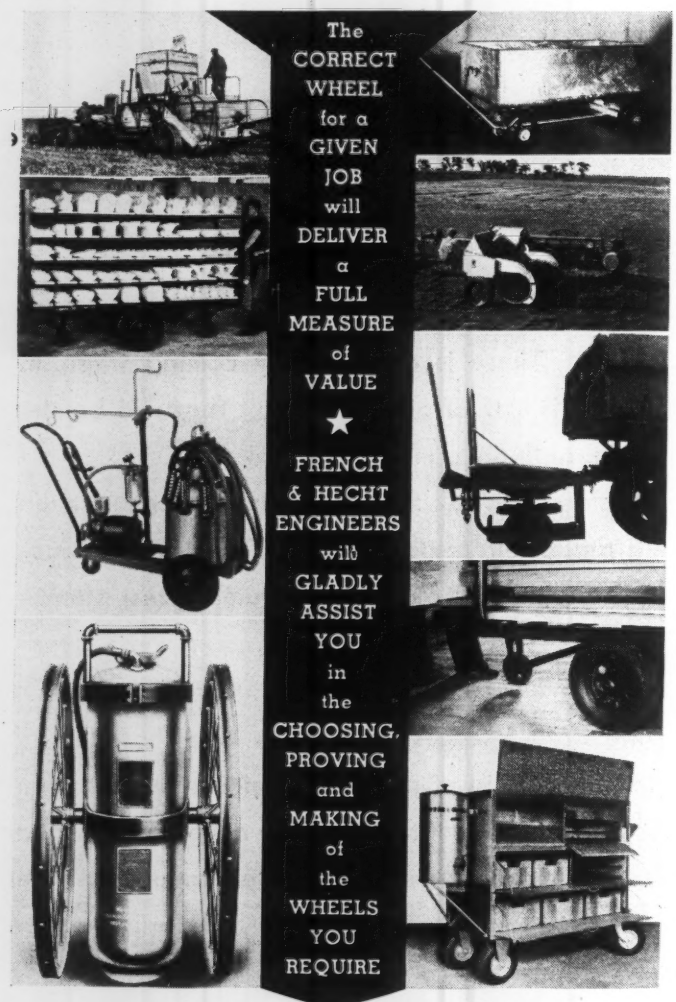
There is a great day coming when, in the words of Kipling, "The silence will be that heavy, one is 'arf afraid to speak." That will be the day of unconditional surrender when those blazing guns, and all guns, will be silenced. ★ ★ ★ ★ ★ ★ Now, it is full speed ahead for each of us. For Leland it is full speed ahead in the production of alternators to power portable gasoline plant for field radios, alternators to power electronic devices on land, sea and in the air; adjustable speed AC to DC units for airplane instrument test stands, polyphase motors to control fire of anti-aircraft gun; DC motors to operate plane landing gear; dynamotors to power radios on motorized vehicles; jeeps, tanks; and other equipment. For the duration Leland's output is largely earmarked for delivery to the armed forces. ★ ★ ★ On that day of *unconditional surrender* it will be full speed ahead on the production of post-war designs. Our solution of the many motor problems now confronting us will obviously benefit peacetime motor buyers and we will be able to remember old friends and new ones with a quality product and a brand of service far ahead of anything that ever went before. ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

THE LELAND ELECTRIC COMPANY ★ DAYTON, OHIO

KNOW HOW

is a Vital Part of BOTH WHEEL SELECTION & WHEEL MANUFACTURE

As specialists in wheel engineering and production, we know that a wheel is more than "just a round thing". The conveyances, mechanisms and equipment that require wheels are directly dependent upon the stamina, speed and reliability of the wheels upon which they are mounted. To those who design new wheeled products for the post-war era—or, who are improving existing lines requiring wheels we offer "KNOW HOW." Promptitude and Economy.


The CORRECT WHEEL for a GIVEN JOB will DELIVER a FULL MEASURE of VALUE
★
FRENCH & HECHT ENGINEERS will GLADLY ASSIST YOU in the CHOOSING, PROVING and MAKING of the WHEELS YOU REQUIRE

We Invite Your Inquiries and Offer You the Benefit of Our Experience and Facilities

F&H WHEELS ARE IMPORTANT

FRENCH & HECHT, INC.

DAVENPORT, IOWA

Wheel Builders Since 1888

MEN OF MACHINES

Formerly assistant chief engineer, C. N. Guerasimoff has been advanced to the position of chief engineer of the engine division of the Buda Co. During the nine years Mr. Guerasimoff has been connected with this company he has served as mathematician, engineer on stress analysis and design engineer on gasoline and diesel engines. From 1939-1940 he was in charge of development and testing of diesel engines, and in August 1941 was appointed assistant chief engineer in charge of the radial diesel engine division. After serving in the World War, Mr. Guerasimoff came to America and graduated from Stevens Institute of Technology with a degree in mechanical engineering. From 1929-1930 he was connected with the Oilgear Co. as design engineer on hydraulic presses and broaches. He then joined the Tornado Motor Co. where he remained until 1934 as assistant chief engineer. Since 1934 he has been associated with the Buda company.

EXTENSIVE experience in both academic and industrial engineering, and in consulting work on mechanical design problems since 1930, Rudolf G. Minarik has been appointed professor of mechanical engineering in the College of Applied Science, Syracuse university. Prior to his present appointment, Dr. Minarik had been connected with Kimberly-Clark Corp. Born in Cleveland in 1907, he obtained his mechanical engineering degree with honors from Case School of Applied Science. He then joined the staff of Sheffield Scientific school of Yale

SLINGSHOT...

with a 1,000,000 pound wallop!

From the deck of a ship a plane is shot into the air ...catapulted by a giant "sling" that imposes a load of about one million pounds on the Hyatt Roller Bearings in its mechanism.

What a wallop!

And what a bearing... that possesses the necessary design, precision and toughness to handle such load extremes!

Years of peacetime experience, in applications undergoing parallel punishment... like ingot cars, mill motors, shaping presses, railroad journals, etc. ...have enabled Hyatt to "inbuild" the stamina needed to take loads as they come.

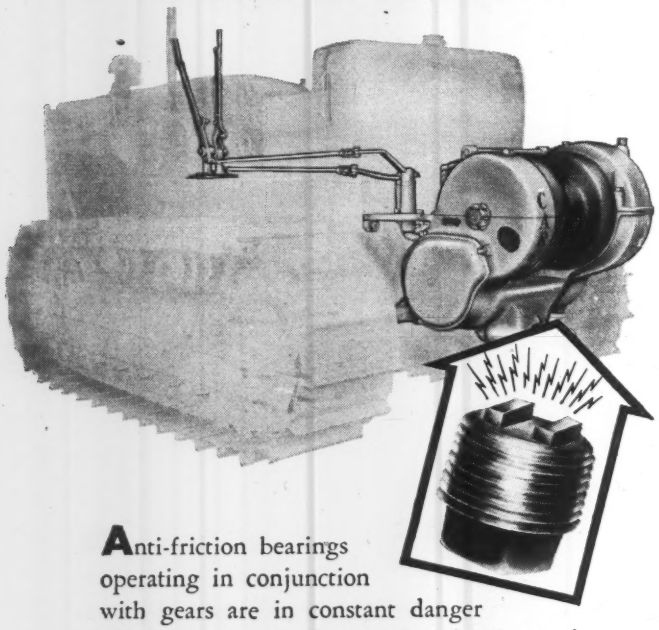
In the battle of production... as on the battlefield... Hyatt Roller Bearings are fighting to win this war.

Fighting against friction... and for America!

Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.

HYATT ROLLER BEARINGS

Safeguarding GEARS AND BEARINGS in CARCO HOISTS



Anti-friction bearings operating in conjunction with gears are in constant danger of excessive wear due to the abrasive action of metal particles which accumulate in the lubricant. Lisle Magnetic Drain Plugs eliminate this danger by *catching and holding the abrasive metal before it does its damage.* Carco Hoists, made by Pacific Car & Foundry Company, offer an excellent example of this type of application. A single Lisle Plug safeguards gears and bearings in the massive 4-stage assembly.

ARMY E NAVY

Write for details on how Lisle Magnetic Plugs can be used effectively in *your* product.

LISLE CORPORATION
Box 1003 • CLARINDA, IOWA

Lisle Magnetic DRAIN PLUGS

university as graduate assistant and received the degree of Master of Science in Mechanical Engineering. While a member of the faculty of the University of California, he received his Doctor of Philosophy in Mechanical Engineering. In 1937 Dr. Minarik left the University of California to accept the position of chief engineer for Vlchek Tool Co., and two years later joined the mechanical engineering faculty of Illinois Institute of Technology where he taught machine design and served as consultant to the Armour Research Foundation. In 1940 he joined Kimberly-Clark Corp. as chief designer and resident consultant on mechanical design for its staff engineering department, and has been technical adviser to the company's ordnance division where he supervised design of special equipment. Dr. Minarik is being retained as consultant on mechanical design by the Kimberly-Clark organization.

♦

JOHN EASTON has been made director of the development and standardization activities of Whiting Corp., Harvey, Ill. A native of Scotland, Mr. Easton's first connection in America was that of Chrysler Corp. Later he was employed in various enginering capacities with several aircraft companies.

♦

HAROLD D. KELSEY, since 1920 connected with General Electric Co., has been appointed assistant to the manager of engineering at the Fort Wayne, Ind., works of the company.

♦

C. L. HUSTON JR. has been elected president of Lukenweld Inc., Coatesville, Pa., succeeding EVERETT CHAPMAN. Mr. Huston is also a member of the board of directors of Lukens Steel Co.

♦

JOHN QUINZIO is now employed by Sterling Engine Co., Buffalo, as designer. He formerly was designer with Columbus McKinnon Chain Corp.

♦

SUNE HERMANSON, formerly chief engineer and metallurgist, Wacho Mfg. Co., has been placed in charge of the metallurgical department, Universal Unit Machinery Co., Milwaukee.

♦

ALBERT KATZ is in charge of development and research for Aga Metal Tube Co., Elizabeth, N. J. He had been development engineer for Bundy Tubing Co.

♦

RUDOLPH F. GAGG has been nominated for the vice presidency of the American Society of Mechanical Engineers. He is assistant to the general manager of Wright Aeronautical Corp., Paterson, N. J.

♦

GEORGE D. EVANS has joined the Columbia Aircraft Corp., Valley Stream, L. I., N. Y., as chief engineer, leaving his position as administrative engineer for the Brewster Aeronautical Corp., Hatboro, Pa.

♦

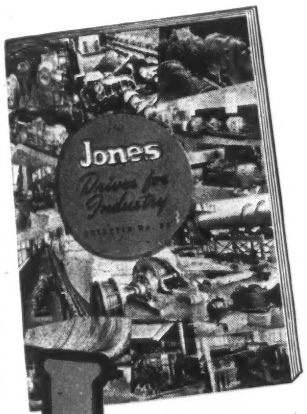
R. A. JEHEBER has been advanced from diesel engineer for Mack Mfg. Corp., Allentown, Pa., to the position of assistant to the chief engineer in the New York office of the company.

When the drive is built into the unit

FOR many years the Jones organization has been developing various types of drive units in which Jones special or standard speed reducers form an important integral part of the unit.

The car puller, door hoist and skip hoist drives illustrated and described here are typical specimens of Jones Unit Drives. These machines are built as complete units by the Jones organization with base to take any motor specified by the purchaser.

The Jones organization has also worked with a great many manufacturers in the application of Jones gears and speed reducers to an extremely wide variety of complete assemblies. You are invited to make full use of this experience in connection with any power transmission problems that you may have.

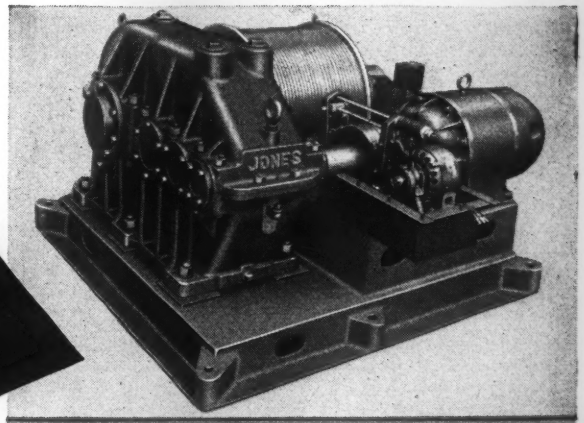


W. A. JONES FOUNDRY & MACHINE CO.
4413 Roosevelt Road
Chicago, Illinois

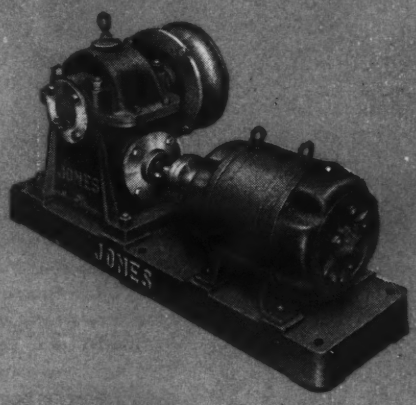
Bulletin No. 80, "Jones Drives for Industry", may be helpful in giving you a complete picture of the Jones products, engineering services and manufacturing facilities that are available for helping you solve your drive problems.

Jones

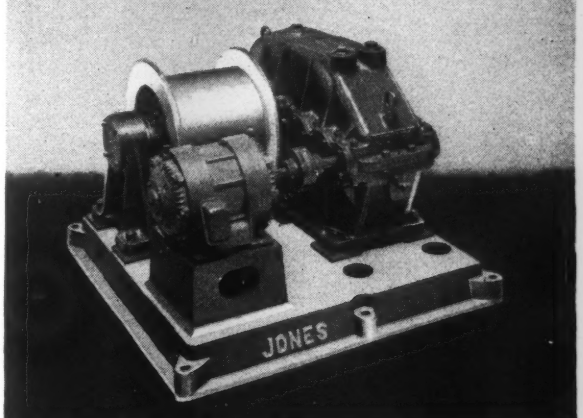
HERRINGBONE—WORM—SPUR—GEAR SPEED REDUCERS • PULLEYS CUT AND MOLDED TOOTH GEARS • V-BELT SHEAVES • ANTI-FRICTION PILLOW BLOCKS • FRICTION CLUTCHES • TRANSMISSION APPLIANCES



● Jones Skip Hoist Drive built as a complete unit by the Jones organization in several types with base to take any motor specified by the purchaser. This drive is equipped with all the modern protective devices such as cam or nut type limit switches, solenoid or disc type brakes and slack cable switches. The drives are single, double or triple reduction Jones Herringbone Speed Reducers.

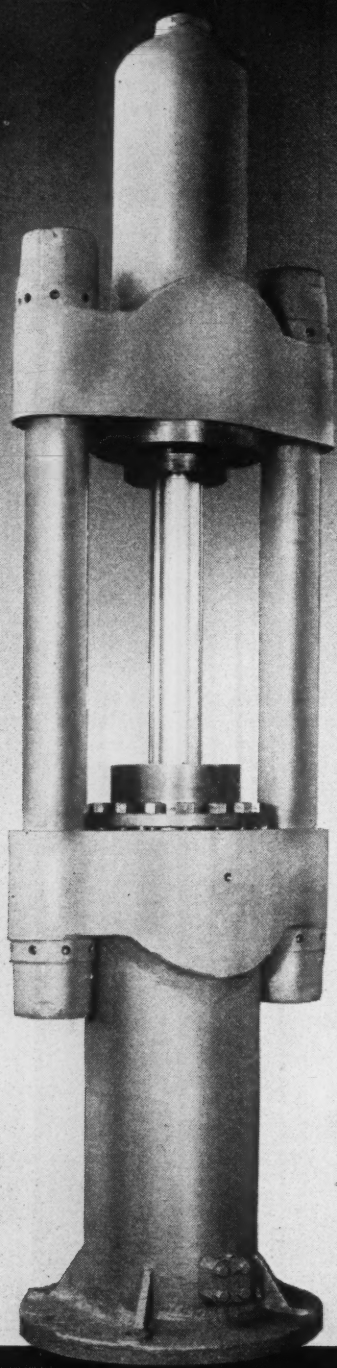


● Jones door hoists are built in many ratings and may be installed with almost any convenient arrangement of sheaves and cables. Base will take any standard motor. No limit switches of any kind are required with this unit.



● A complete Jones car puller unit. These outfits are for use with wire rope and are manufactured in a wide range of capacities to suit the number of cars to be handled in each plant.

This Intensifier is typical of
HYDRO • POWER
Equipment designed for
Special Hydraulic Applications



This tandem ram type intensifier increases hydraulic line pressure from 2,500 to 15,000 pounds per square inch. Regardless of the size and scope of your hydraulic requirements, HYDRO-POWER will do the job faster and cheaper. ● All members of HYDRO-POWER equipment are of sturdy proportions . . . working parts are finished with close tolerances. High hydraulic efficiency is guaranteed; maintenance costs are negligible. Write today stating your particular hydraulic requirements. HYDRO-POWER engineers will be glad to assist you in designing hydraulics into your present and post-war equipment.

HYDRO-POWER SYSTEMS, INC.
Division of The Hydraulic Press Mfg. Co.
MOUNT GILEAD, OHIO
U. S. A.

hydro power

HYDRO-POWER
HYDRAULIC PUMPS AND CONTROLS - VALVES - CYLINDER AND RAM ASSEMBLIES - POWER UNITS - SYSTEMS - SPECIAL HYDRAULIC EQUIPMENT.

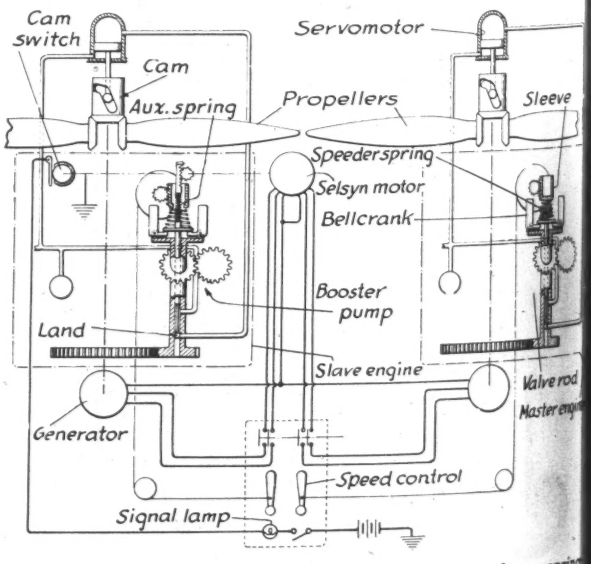
NOTEWORTHY PATENTS

Synchronizes Speeds of Multiple Engines

SYNCHRONIZATION of the speeds of multiple power units, such as internal combustion engines, is accomplished with a minimum amount of additional equipment over and above that normally required for speed regulation, through the use of a control system covered by patent 2,319,218, recently assigned to Woodward Governor Co. The system provides for manual adjustment of the speed of each power unit over a wide range and automatic synchronization of one or more "slave" units with a master unit over a comparatively narrow speed range. The speed-matching control includes means to indicate when the slave unit is adjusted for operation at a predetermined point within its automatic speed range.

An example of the application of the synchronizing control system is shown in the accompanying illustration, which is a schematic view and wiring diagram of a two-engine system for an airplane. Provision is made for individual manual speed adjustment of master and slave engines for operation at any speed and for automatic adjustment of the slave engine speed to match the selected speed of the master unit. The speeds of the engines are controlled by individual governors in the usual manner through adjustment of the propeller pitch. Hydraulic pressure controlled by the governor is applied to a servomotor which actuates a cam by which the pitch of the propeller is changed.

Governors are of similar construction, each including a head on the upper end of a sleeve which rotates in the



Speed of slave engine is regulated by auxiliary spring acting on governor valve rod. Auxiliary spring pressure is controlled by selsyn motor having stator and rotor windings connected, respectively, to generators driven by the master and slave engines

Now... shipboard cable is armored with STEEL!

RESULT:

- *increased bursting and bending strength*
- *improved resistance to salt water corrosion*
- *greater abrasion resistance*
- *no loss in flexibility*
- *no increase in weight per foot*
- *lower cost*
- *easier cable repairs and connection*

NOT even a movie queen guards her poundage more closely than the naval architect or ship designer watches deadweight in ship construction.

The weight per foot of shipboard cable has been figured down to the ounce and ships have been designed for this fixed figure.

That's what made the job so tough when our engineers were asked to develop an alternate material for cable armor. With no increase in weight permissible, steel seemed to be ruled out. But not for long.

After a number of tests we developed the lightweight steel armor shown on this cable. By reducing thickness and by opening up the weave, the weight per foot was kept within the old limits. And by using steel, every desirable quality previously obtained was equalled or considerably improved.

We are proud to have pioneered this development. It is typical of the wire-making "know-how" that has helped us solve one tough war problem after another. From this background of war-stimulated progress will come new and finer products to serve you more efficiently in the coming years of peace.

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

USS

Wire for War Products
MANUFACTURERS' WIRES · COLD ROLLED STRIP STEEL · SPRING WIRE · COLD FINISHED STEEL BARS · STAINLESS STEEL WIRE SPRINGS · WELDING WIRE

UNITED STATES STEEL

SHIPPED AT PEACE-TIME SPEED

GILBARCO COOLANT PUMPS are made by one of the country's largest pump manufacturers for all machine operations. Rugged and durable, they are built for 24 hours a day service.

STANDARD MOTORS Pumps with motors for all regular voltages and cycles, two or three phase, shipped promptly.

SPECIAL MOTORS Facilities for winding motors for unusual electrical characteristics enable us to ship almost as promptly as standard units.

Write or wire for literature and prices

GILBERT & BARKER MFG. CO.
WEST SPRINGFIELD, MASS.

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JOHN HASSALL, INC.
Send for this FREE CHART
Decimal Equivalents. Accurate to four places. Signaled in three colors for maximum speed in locating decimal equivalent of fraction. Saves time and avoids errors. Yours at no cost or obligation. Just send us your name, title and address.
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Specialists in Cold-Forging Since 1850
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Brooklyn 22, N. Y.
SPECIAL NAILS RIVETS SCREWS
Hassall

bore of a hollow casing. Flyballs in the form of bell-cranks are pivoted on the head and have arms bearing upwardly against the outer race of a ball bearing, the inner race of which fits on a valve rod and is urged downward by a coiled speeder spring acting on a collar on the upper end of the rod. Through a suitable gear connection the lower end of the sleeve is driven from the crankshaft of the engine. Speed increase raises pilot valve member, permitting flow of fluid out of the head of the servo-cylinder and into the rod end, which results in an increase in the propeller pitch and causes a drop in speed.

To provide for manual adjustment of the governor speed setting, the upper end of each speeder spring bears against a sleeve formed with rack teeth which mesh with a pinion. Pinion shaft carries a pulley around which is wrapped a cable extending to an operating lever at the main control station.

Auxiliary Control Is Automatic

The present invention provides an auxiliary control superimposed on the control system just described, which is typical of those now in common use. An auxiliary, independently adjustable spring is incorporated in the governor of the slave engine to supplement the action of the main speeder spring. This spring, which is concentric with the main speeder spring, has its lower end threaded to the valve rod and its upper end threaded to the lower end of the rack bar with teeth which mesh with a pinion. Rotation of the pinion varies the tensile or compressive stress exerted by the spring on the valve rod. Automatic adjustment of the spring is effected by a selsyn motor which drives the pinion.

This motor comprises a stator and a rotor excited from independent sources of three-phase alternating current which produce rotating fields in both rotor and stator. When the stator and rotor are energized at different frequencies the motor operates in a corresponding direction to raise or lower the rack and thus extend or compress the spring so long as the speed difference persists. The master and slave engines are equipped with small permanent magnet generators driven from each crankshaft, one of which is connected to the rotor of the selsyn motor and the other to the stator.

If the engines are operating at the same speed the frequencies of the two alternating current sources are identical and there is no mechanical movement of the selsyn motor shaft. When the speeds are different the frequencies of the generated current vary proportionately and the motor shaft turns in a direction determined by which speed is greater. The auxiliary spring of the slave engine governor is thus adjusted to change the speed of the setting and thereby bring the slave engine back into synchronism with the master engine.

In order to equalize the speed deviations of the slave engine that may be corrected for on each side of the speed of the master engine, means are provided for indicating when the stress in the auxiliary spring is zero and the speed settings of the two governors are identical. This comprises an electric signal lamp which lights when the adjuster is at the middle of its range of movement, the energizing of the lamp being effected by a cam-actuated switch operated by the adjuster shaft.

when the smoke of battle clears away!

The post-war world will be strange and new. Products hitherto unknown, or at least greatly improved, will make the scientific marvels of today seem dull and commonplace. This Company is fully prepared for that happy era. The advances in the mass production of precision, custom-cut gears have been born in the fiery crucible of war. Take advantage of the new techniques so developed by Perkins. Ensure now that you and your post-war product will be ready. Consult with our engineering staff on any problem involving the production of gears for the efficient transmission of power.

PERKINS PRECISION, CUSTOM-CUT GEARS

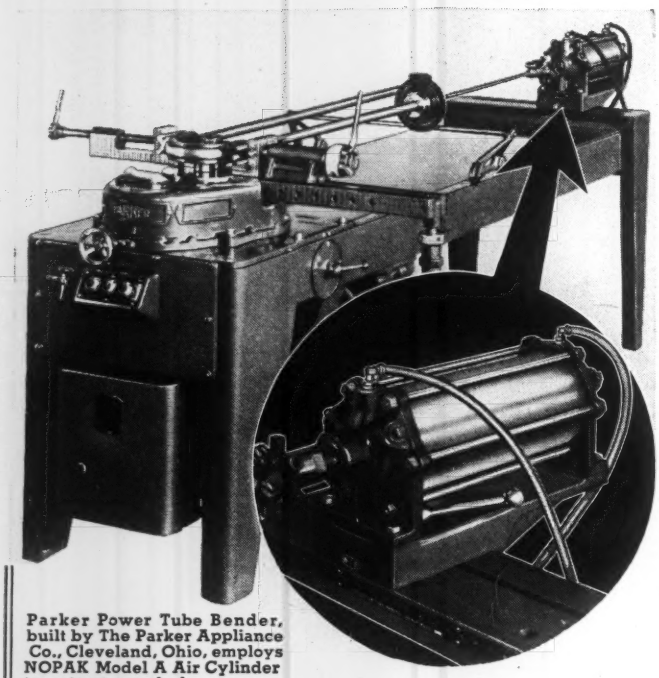
help power American Planes, Tanks and Guns

PERKINS MAKES:

Helical Gears	*Bevel Gears*	*Ratchets*
Worm Gears	*Spiral Gears*	*Spur Gears*

Ground Thread Worms

PERKINS MACHINE & GEAR COMPANY, SPRINGFIELD, MASS.



Parker Power Tube Bender, built by The Parker Appliance Co., Cleveland, Ohio, employs NOPAK Model A Air Cylinder to extract mandrel.

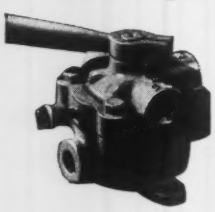
NOPAK Cylinder Power

Extracts the Mandrel on Tube Bending Operation

Before tubes or pipes are bent on Parker Power Tube Benders, a mandrel is inserted to prevent crimping at the point of bend. After the bending operation, this mandrel must be extracted without loss of time so that the machine can function at top efficiency.

The powerful pull required to extract the mandrel is supplied by a NOPAK Model A Air Cylinder. The diameter and stroke of the cylinder depends upon the size and capacity of the machine on which it is used. Speed, strength, stamina and uniform pulling power are the basic requirements of air cylinders employed on Parker Power Benders.

This application of NOPAK Cylinders may suggest how you can use NOPAK Cylinder Power to step up certain operations on the machines you build for resale, or use for production in your own plant.



Write for Illustrated Bulletin No. 82-A

NOPAK 2-, 3- and 4-Way Valves provide positive, precision control of Air and Hydraulic cylinder power. Hand, Foot and Solenoid Operated.

GALLAND-HENNING MFG. CO.
2752 SOUTH 31st STREET • MILWAUKEE 7, WISCONSIN
Representatives in Principal Cities

NOPAK VALVES and CYLINDERS
DESIGNED for AIR or HYDRAULIC SERVICE

A 4180-½

Selecting Metallic Coatings

(*Continued from Page* 90)

a great deal to localize the hardening of steel machine parts. For example, in the case of a shaft which must be hardened and polished locally where it passes through an oil seal, that portion of the shaft which does not require hardening is copper plated by electrodeposition or metal spraying. If electrodeposition is employed, the portion of the shaft to be hardened is first coated with a "stopping off" compound and the remainder plated with copper. During carburization, the compound is burned off and the base metal is thus exposed. However, the carburizing gas cannot penetrate the copper coating and so the remainder of the shaft will not harden. A coating .0005-inch thick is usually sufficient in such cases.

When copper coating for localization of hardening is applied by metal spraying, the portion of the part to be hardened is masked off, for example by taping, and a heavier coating than would be the case with electroplating is deposited.

Base Coating Utilization

Another extensive application of electroplated copper is for supplying the undercoat of nickel and nickel-chromium finishes. However, copper by itself cannot be recommended as a good corrosion-resistant coating since it is cathodic to iron and steel and any coating porosity results in the development of rust spots.

INDIUM: Since twenty years ago, research has served to develop this metal from obscurity to a commercial alloying and plating adjunct with promising potentialities. A noteworthy application is its electroplating in conjunction with lead on silver high-speed, heavily loaded bearings, where its use indicates enhancement of resistance to corrosion, fatigue and friction.

Minute quantities of indium, when plated over base coatings of silver, tin, lead, zinc, etc., will, after being diffused with the base coating by application of heat, improve resistance to wear and corrosion. A .0005-inch thick coating of cadmium which has been diffused with a small percentage of indium presents a highly reflective surface, similar to silver in color, suggesting possible use on lamps and reflectors.

As a tarnish and corrosion-resistant coating on brass, copper and bronze machine parts, indium, by diffusing with the base metal, produces an alloy layer which is harder than the base metal, facilitates soldering and is not subject to cracks or pinholes. The low coefficient of friction of the alloy layer indicates application to brass or bronze gears, bearings, etc.

LEAD: Coatings of lead are usually applied by either hot dipping or electroplating. In considering the corrosion-resistant qualities of lead on steel, Dr. Bruce W. Gonser of the Battelle Memorial Institute offers the following: "The potential applications are many and the next few years should see considerable increase in the use of lead coatings. One handicap at present is the tendency of lead-coated steel to show rust stains rather quickly and to attain a disreputable appearance. From

It takes more than *Gun-Coolant* to knock out an R&M MOYNO PUMP!

"NO REPAIRS NEEDED FOR MOYNO UNITS AFTER 2 YEARS SERVICE ON THIS TOUGH WAR JOB"

Photograph shows Milburn Anderson, foreman, with R & M Moyno Pump in plant of Struthers Wells Corporation, Titusville, Pa.

Gun-coolant itself isn't so hard to pump, but the abrasive sediment that it picks up is a pump *destroyer*. That is why the record of R & M Moyno pumps in the plant of the Struthers Wells Corporation of Titusville, Pa., has a real meaning for pump users. In two years on this job not a single Moyno unit has required *any* repairs. Furthermore, the easy portability of these Moynos has permitted their use as powerful auxiliaries in pumping emergencies.

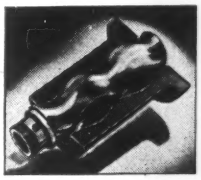
You can depend upon a Moyno to pump just about anything that can flow through a pipe—molten resin, vitreous enamel, glucose, propane gas, liquid carbon dioxide. Moyno handles such liquids and semi-solids faster and with far greater economy than ordinary pumps.

There is no piston or valve wear with a Moyno—because Moyno doesn't have pistons or valves. Cavitation and pulsation are eliminated—because the exclusive Moyno principle produces a flow that is constant and uniform. The compact design is so simple that an installation can be completely dismantled and reassembled in 30 minutes.

Regardless of the kind of pumping problem you may have, don't fail to get the full facts about the R & M Moyno. Write us, stating the problem, and we will tell you how Moyno can serve you.

ONLY 1 MOVING PART!

Here's the patented principle of the R & M Moyno Pump's amazing performance. A single-threaded helical rotor revolves within a double-threaded helical stator, providing pumping action like that of a piston moving through a cylinder of infinite length.



ROBBINS & MYERS • Inc.

MOYNO PUMP DIVISION SPRINGFIELD, OHIO

In Canada: Robbins & Myers Co. of Canada, Ltd., Brantford, Ont.

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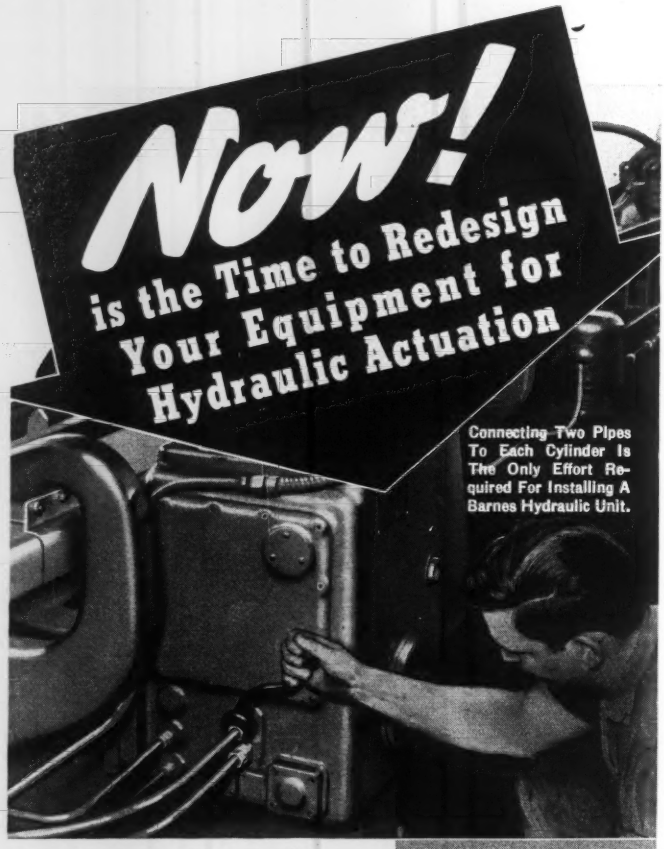
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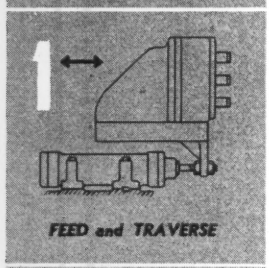
is the Time to Redesign
Your Equipment for
Hydraulic Actuation
Connecting Two Pipes To Each Cylinder Is The Only Effort Required For Installing A Barnes Hydraulic Unit.

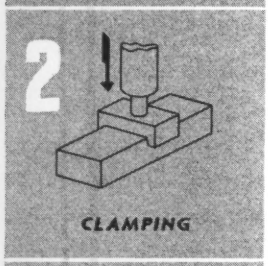
Get Any Combination of These 3 Machine Functions With BARNES Hydraulic Units...

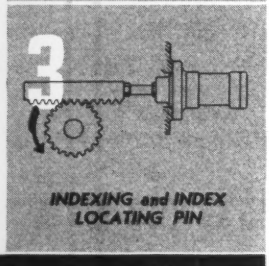
When designing or redesigning machines, save design and assembly time, improve machine performance, and speed delivery by using Barnes Unit-Type hydraulics. You merely establish the functions to be done hydraulically — our engineers design the proper circuit while you design the machine itself. All hydraulic elements come from one source—eliminating divided responsibility for performance.

When your machine is ready for assembly, a complete hydraulic circuit is shipped to you in compact, self - contained units or panels, ready to install.

The complete unit is designed and tested for the specific functions of your machine and includes the proper combination of feed, traverse, indexing, clamping or similar functions.







★

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John S. Barnes Corporation

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MAIN OFFICE
AND FACTORY
ROCKFORD, ILL.

the corrosion standpoint this does little harm since the exposed iron appears to be effectively sealed by corrosion products and some of the stains may actually disappear in time. This poor appearance is a definite handicap, however, in securing customer acceptance, and we are doing some work in an effort to remedy this condition."

Dr. Gonser points out, however, that lead coatings form a particularly effective base for paints where, unlike galvanized coatings, they require no aging or other treatment to insure proper adherence.

When electroplated lead coatings on the order of .003-inch thick are applied to machine parts, they afford good corrosion resistance. However, as has been indicated above, the rust spotting along with a none too lustrous bluish-gray color, serves to detract materially from the decorative value.

Lead Gaining Prominence

In the prewar period, this coating was used principally on items requiring resistance to chemical corrosion and weathering effects, such as tanks, storage battery fittings, outdoor structural members, etc. More recently, however, under the influence of exigencies brought about by wartime materials restrictions, lead coating has invaded the field of machine parts such as coil springs, packing rings, gaskets, nuts, bolts, etc. Because it is soft it will not offer appreciable resistance to abrasion, although it does have desirable frictional properties and thus makes a good bearing surface for many purposes. Lead-coated parts should be kept out of direct contact with aluminum since the galvanic couple thus established will tend to accelerate corrosion in the presence of moisture.

NICKEL: As specifically employed on machine parts, nickel coatings are most generally applied by electroplating. Other methods of application are utilized, however, including spraying, sputtering and evaporation.

For nickel plate to serve effectively as a corrosion-resistant coating requires that it be applied over a base coating of copper and present a surface which is substantially free of porosity. Coatings .001-inch thick are usually almost entirely pore-free and offer good resistance to the corroding action of water, various salt solutions, marine, rural and industrial atmospheres.

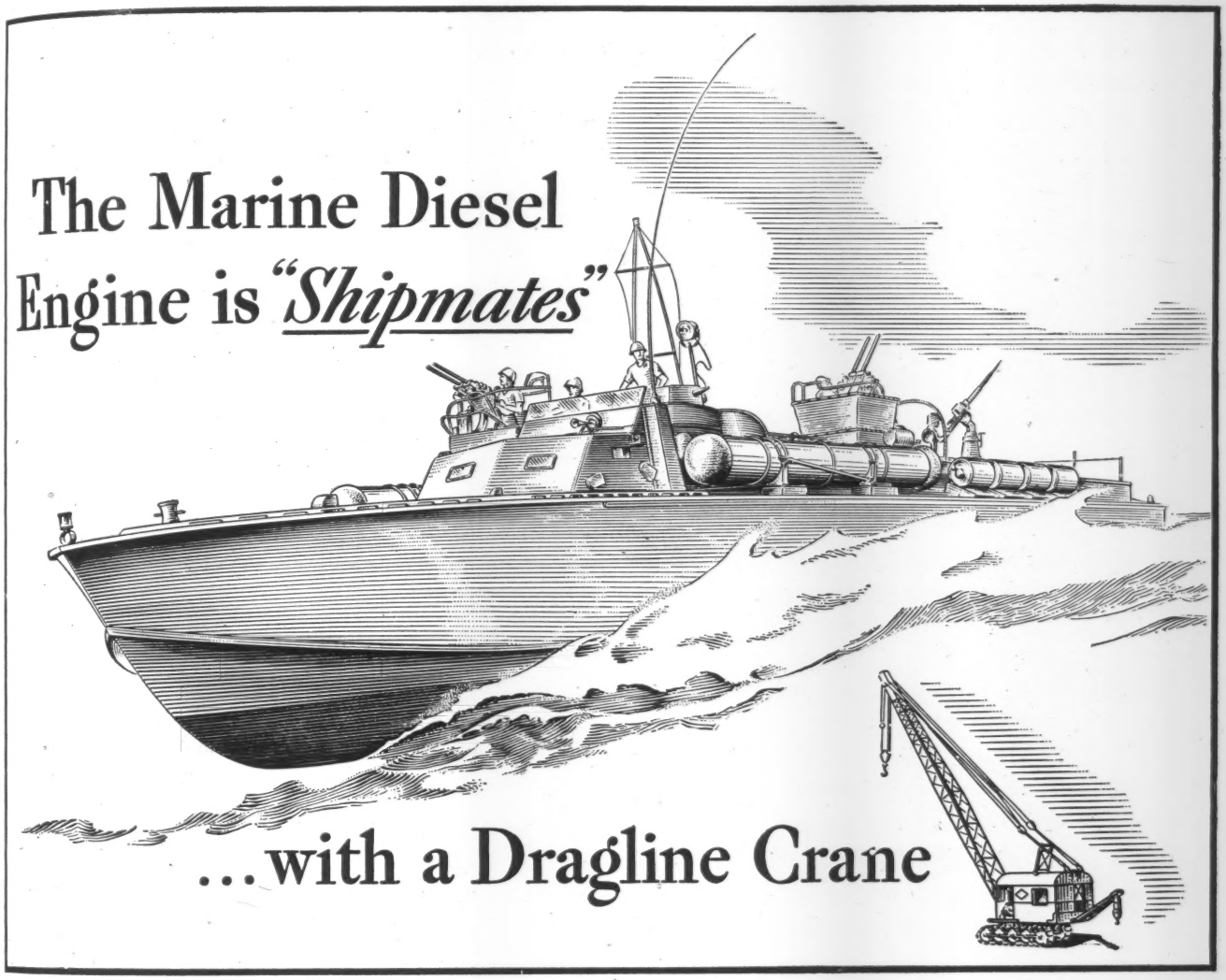
Development of commercial "bright" nickel is comparatively recent. Before its advent, nickel base coatings for chromium required a buffing operation to bring their surfaces up to the highly polished condition needed. A process has been developed whereby bright nickel as deposited on strip steel is soft enough to permit the strip to be blanked and formed after the nickel plate is applied.

Nickel coatings on machine parts are used for substantially the same purposes that chromium is utilized, the difference being that nickel will tarnish and corrode more readily than chromium and, not being as hard, will show less resistance to wear and abrasion. However, where the application requirements are not stringent enough to predicate the use of chromium, or where the additional cost of chromium is a controlling factor, nickel can be used advantageously.

TIN: Although recognized most generally for its predominance in the canning industry, tin plating, both by

(*Concluded on Page* 288)

The Marine Diesel Engine is "*Shipmates*" ...with a Dragline Crane



YOU MIGHT WONDER at the connection between a Marine Diesel engine and a dragline crane. The crane's is a back-breaking job in all kinds of weather, and maintenance must be taken with a grain of salt. Knowing this, crane companies wisely choose the Torrington Needle Bearing, famed for high load capacity, efficient lubrication and minimum service attention required.

Now the Marine Diesel engine is something else again—a miracle of compact engineering design that's got to be so thoroughly dependable...so all-fired ready at the bark of a command that selection of even small parts becomes a major consideration. So the Marine Diesel designers, too, specified the Needle Bearing—for its small size and reliable performance. But they discovered some other features that were right "on target," although hardly expected in a bearing.

The low starting friction of this unique anti-friction bearing, for example, meant quicker engine response, and maybe sub and PT-boat crews don't appreciate that. High load capacity helped prevent overloading, keeping more ships in fighting trim more of the time. The Needle Bearing's light weight saved pounds on board for fuel and ammunition, while its ready availability for essential applications enabled engine builders to go ahead on the Marine Diesel production that helped turn the tide in the battle of the Atlantic.

NEEDLE BEARINGS—ALL TYPES—ALL SIZES

NEEDLE BEARINGS TYPE DC are complete, self-contained units consisting of a full complement of rollers and a drawn, hardened outer race. They offer the advantages of small size, low cost, high capacity—and easy installation.

NEEDLE BEARINGS TYPE NCS consist of a full complement of rollers and a relatively heavy hardened outer race. They are furnished with or without inner races. Needle Bearings Type NCS are adaptable to heavier loads than Needle Bearings Type DC.

NEEDLE ROLLERS TYPE LN are produced in a range of types and sizes for assembly on the job into low-cost, high-capacity, anti-friction bearing units. Our engineering department will be glad to advise on the correct size and type for any application.

HAS THIS GIVEN YOU AN IDEA for your post-war designs? You may find the answer to one of your problems in the Needle Bearing's unique combination of features. For these are what your customers have been educated by war's developments to want in the peacetime products they plan to buy. Light weight, compact design, ease of installation, infrequent maintenance, long life—here are Tomorrow's sales points, and they add up to the Needle Bearing. Let a Torrington engineer show you how *you* can adapt the Needle Bearing's advantages to your product's design. For preliminary information, send for Catalog No. 109 which lists sizes, types and ratings, together with a list of typical applications.

THE TORRINGTON COMPANY

Established 1866 • Torrington, Conn. • South Bend 21, Ind

Makers of Needle Bearings and Needle Bearing Rollers

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Detroit Cleveland Seattle
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TORRINGTON NEEDLE BEARINGS

HOBART'S PRACTICAL DESIGN FOR ARC WELDING

WHY SHOULD YOU CHOOSE HOBART "SIMPLIFIED" Arc Welding?

Hobart's compact design, 1000 combinations of voltage and current combined with exclusive Remote Control gives you better welding results. It's today's most outstanding Welder. Ask us for catalog.

Here for the first time is a really practical welding design service. It shows hundreds of ways to use steel bars, plates, sheets, angles, channels, beams, pipe, tubing and flame cut sections in designing products for Arc Welding.

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Complete in every respect.
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(*Concluded from Page* 284)

hot-dipping and electroplating, also finds application in the machine field. As applied to iron castings, the hand-dipping process is employed. In this the parts are immersed in a bath of molten tin, being fluxed by zinc chloride. Proper cleaning and preparation of the surface to be coated is of primary importance as a less than thorough job at this juncture of the process results in poor coverage and insecure adhesion. Often a film of copper, precipitated from solution, is applied immediately preceding the actual dipping. Experience shows that iron castings, if given an annealing treatment resulting in surface decarbonization, will accept tin coatings more readily than untreated castings.

Metal spraying of tin is readily accomplished, the coating thus imparted usually being thicker than those resulting from employment of hot-dipping or electroplating.

In the absence of air, tin plate has excellent corrosion-resistant properties in regard to the action of neutral and mildly acid solutions. Again, in the presence of ordinary or industrial atmospheres, its corrosion resistance is good. However, when subject to marine atmospheres, it has only fair corrosion resistance.

ZINC: Three processes of application are employed for most zinc coating: Hot-dipping, electroplating and cementation. The last mentioned, as specifically applied to zinc, is also known as "sherardizing".[3] Sheet iron and steel, wire mesh, wire, etc., are usually coated by hot-dipping, while machine parts such as castings, forgings, stampings, etc., are electroplated or "sherardized".

Improvement of Decorative Values

Of comparatively recent origin, "bright" zinc plating by various modifications of the electroplating process offers a brilliant metallic luster much more decorative than the ordinary zinc plating which is dull blue-gray in appearance. However, all zinc coatings will darken in time and a film of clear lacquer is sometimes applied to prevent discoloration. Since electroplated zinc will tolerate more severe bending and deformation than the dipped or cemented type, it can be used on such parts as springs.

In common with cadmium, zinc—being anodic to iron—provides "sacrificial" corrosion protection to this base metal. Where proper thickness and uniformity of coating is effected, corrosion resistance is about the same for zinc coatings applied by electroplating, hot-dipping or cementation. They offer fair protection where exposed outdoors in highly contaminated industrial atmospheres and excellent protection in rural atmospheres. Good protection is afforded in marine atmospheres. When exposed indoors at similar localities, the protective values are considerably higher.

Thicknesses of zinc coatings, as most generally employed, range from a few ten-thousandths to a few thousandths of an inch and depend on the corrosion characteristics to which the particular part is to be subjected.

Cooperation of the following companies in supplying data and illustrations is gratefully acknowledged: Metallizing Engineering Co. Inc., *Fig.* 1; Van Der Horst Corp. of America, *Fig.* 2; The Indium Corporation of America; and Metallizing Co. of America.

[3]From Sherard Cowper Coles who originated the process.

Utilization of electrical horsepower is an accurate gauge to progress, both industrial and social. American industry used 33,844,131 h.p. in 1929, jumped to 45,291,319 in 1939, and, since 1939, has gained more than any other two countries in the world. For the past 27 years, Howell Motors have supplied an ever-increasing amount of horsepower for American industries. Today, Howells are serving every important industry in America.

HORSEPOWER

BY HOWELL - FOR YOUR INDUSTRY

You're looking at the electric motor that has won a high place in American industry for dependability, quiet operation and honest value.

It is a precision-built motor throughout.

In wartime production, where time is precious and delays are disastrous, here is another feature of Howell Motors you cannot afford to overlook:

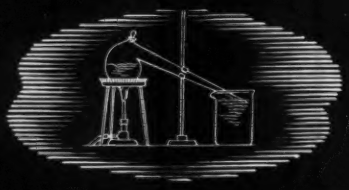
You can load them with full confidence in their ability to stand up under the toughest jobs you can assign within the limits of safety.

Now that the War Production Board requires you to use electric motors of the lowest possible horsepower you are safe in specifying horsepower by Howell.

Let Howell engineers aid you in selecting the proper rated motors for your requirements and obtain this safety factor which is so vital in these times.

HOWELL ELECTRIC MOTORS COMPANY
HOWELL, MICHIGAN
Manufacturers of Quality Motors Since 1915

The **HOWELL IDEA**
in Electric Motors
precision-built



Lessons From The War

From our wartime experience we can say this: When peace comes, Americans will enjoy the comfort and convenience of many strange new devices which are today devoted to military purposes. They will not only extend our span of life but also make it pleasanter in many ways. The 4-plant facilities of The Weatherhead Company are prepared to help you build these peacetime products just as we've helped to build America's cars and planes and refrigerators in the past. We offer you better designing than ever, much lowered production costs and a highly efficient service organization.

Look Ahead with

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THE WEATHERHEAD CO., CLEVELAND, OHIO

Manufacturers of vital parts for the automotive, aviation, refrigeration and other key industries.

Plants: Cleveland, Columbia City, Ind., Los Angeles
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BUSINESS AND SALES BRIEFS

KENNAMETAL INC., with factories and main office at Latrobe, Pa., is opening a Philadelphia office and warehouse at 3701 North Broad street, Philadelphia, for the sale, engineering and service of the company's products in the area comprising Eastern Pennsylvania, Southern New Jersey, Maryland, District of Columbia, Virginia and certain other specific areas. Wm. S. Jones is in charge of the new office, and Burton E. Middleton, who had been in the company's Rochester, N. Y., office, will be transferred to the new branch.

◆

P. S. Jones will undertake new duties as general sales manager for Cutler-Hammer Inc., Milwaukee, having direct supervision of sales through the organization's thirty selling territories in the country. Mr. Jones joined the company as sales engineer in 1915. For fourteen years prior to his appointment he was in charge of the New York sales territory.

◆

In his new post as general manager of all divisions of The Timken Roller Bearing Co. on the entire West Coast and in the Orient, W. H. Richardson will be in complete charge of sales and merchandising of roller bearings for original equipment in that territory. Mr. Richardson became connected with Timken in 1917, and served in various sales capacities until 1941 when he was made assistant general sales manager.

◆

Advancement of J. W. Burdick from salesman to assistant district manager of the Springfield, Mass. office has been made by Allegheny Ludlum Steel Corp. Another appointment is that of J. T. Purtell who has been added as a salesman to the Springfield district office. He was transferred from his former location at the company's Watervliet, N. Y., plant.

◆

At a recent meeting of the board of directors of American Agile Corp., Cleveland, Dr. J. A. Neumann was appointed president of the company. He will continue his activities as director of research.

◆

Van Norman Machine Tool Co., Springfield 7, Mass., has changed its name to Van Norman Co., in order to eliminate the implication that activities of the company are or will be confined solely to the production of machine tools.

◆

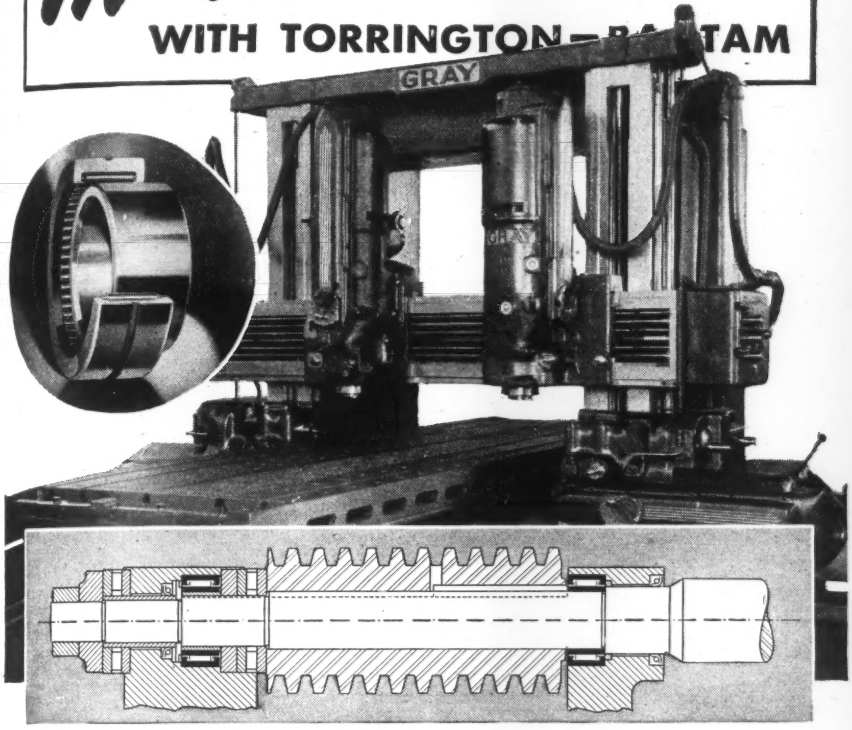
According to an announcement by General Electric Co., Arthur A. Brandt, George W. Henyan and V. M. Lucas have been appointed to new positions in the Electronics department. Mr. Brandt becomes general sales manager, responsible for coordination of sales, plans and policies of the several divisions; Mr. Henyan is assistant to the vice president of the department, and Mr. Lucas is manager of the government division.

◆

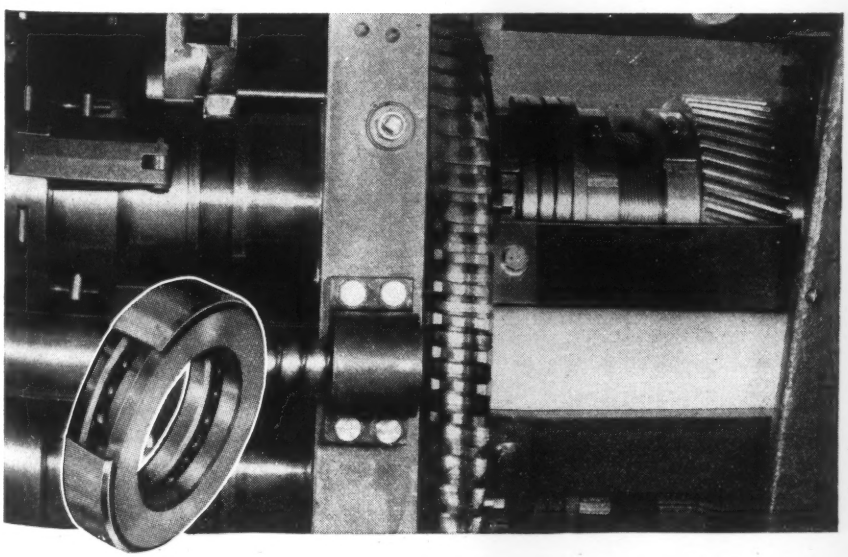
Opening of an eastern sales office at 2003 Fisk building, 250 West Fifty-seventh street, New York, has been announced by John S. Barnes Corp., Rockford, Ill. The office is under the supervision of E. C. Hawkins, formerly chief engineer, LeMaire Tool & Mfg. Co., Detroit. Another announcement made by the company is that of the appointment of Henry C.

IN THE NEWS

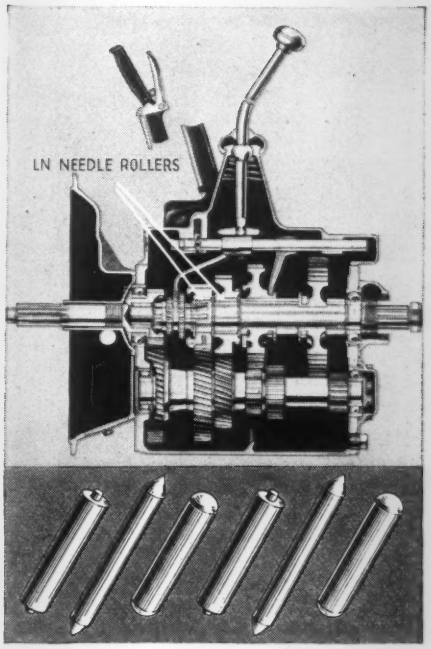
WITH TORRINGTON—BANTAM



SPEED, FLEXIBILITY AND EASE OF CONTROL, usually confined to small knee-type machines, characterize this Planer Type Milling Machine manufactured by the G. A. Gray Company. Type NCS Needle Bearings and Roller Thrust Bearings are combined in an application on the spiral pinion mounting, as illustrated in the cross-section drawing. Because this pinion drives the heavy work and work table, and because torsional stiffness is a prime requisite, it is necessary to keep the pinion diameter small and the shaft diameter as large as possible.

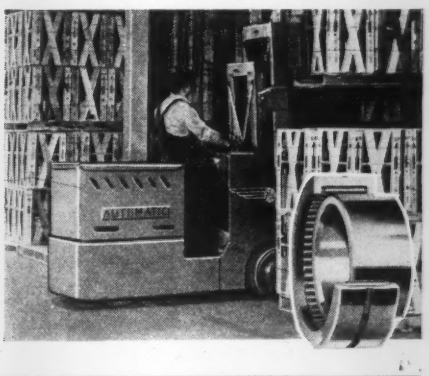


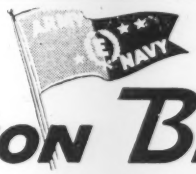
SPEED FOR WARTIME PRODUCTION has been the result of increased output of machine tools such as this Four Spindle Automatic Lathe manufactured by the Cone Automatic Machine Company, Inc. Among the many engineering features that contribute to the outstanding performance of these automatic lathes is the use on the work spindles of two types of Special Thrust Ball Bearings built by the Bantam Bearings Division, one of them measuring 9" O.D., 6¼" I.D., and 1⅞" in thickness, and the other 8¾", 6", and 1⅞".



UNUSUAL EASE IN SHIFTING, as well as quietness and long life under heavy service, are a few of the virtues of this Helical Gear Transmission manufactured by the Clark Equipment Company. The illustration shows the application of the high load capacity Type LN Needle Rollers on the mainshaft constant mesh gears, which contribute materially to the exceptional efficiency of this transmission. All types of Needle Rollers are included in the complete Torrington line. Our engineering department will be glad to make recommendations on the selection of the right type for your needs.

LIFTING TWO-AND-A-HALF TON LOADS is the job of the Standard Fork Truck illustrated here. Built by the Automatic Transportation Company, Type NCS Needle Bearings were selected for the sprockets at the top and bottom of the chain hoist which raises the telescopic uprights. Type NCS Needle Bearings with their high load capacity, ease of efficient lubrication and low friction coefficient are ideal for such heavy-duty applications.



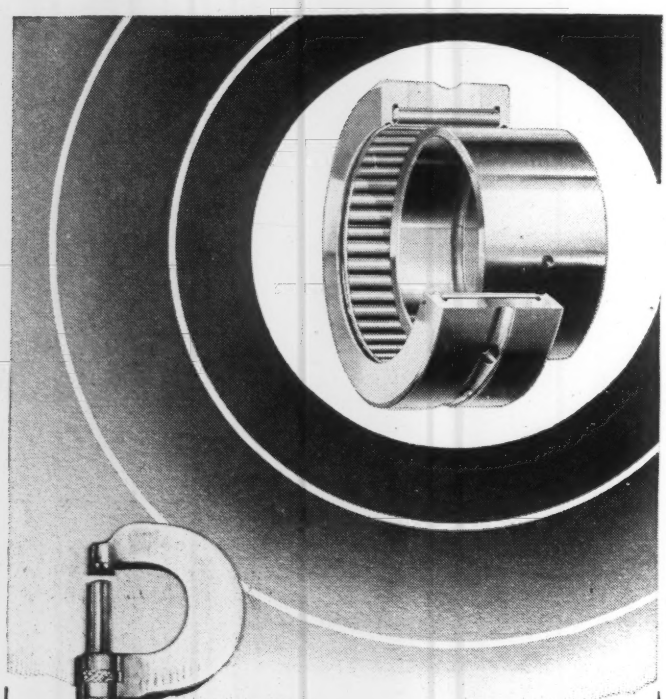


TORRINGTON BEARINGS

STRAIGHT ROLLER · TAPERED ROLLER · NEEDLE · BALL

THE TORRINGTON COMPANY · BANTAM BEARINGS DIVISION

SOUTH BEND 21, INDIANA



Precision
TOLERANCE

The close tolerances regularly built into McGILL "Solidend" *MULTI-ROL* Full Type roller bearings are the result of painstaking McGILL manufacturing standards. Each fabricating operation is followed by a rigid inspection which sees to it that these close tolerances are maintained.

That such care makes a difference is shown in the ever-increasing use of these long-lived bearings wherever "full speed ahead" demands the reliability, the economy and the greater load capacity of McGILL "Solidend" Bearings.

Use your priority to secure McGILL "Solidend" superiority.

McGILL MANUFACTURING COMPANY, INC.
VALPARAISO, IND.
BEARING DIVISION — 1450 N. Lafayette St.

Hoss, 4301 Park avenue, Indianapolis, as sales representative for the company's hydraulic line in the state of Indiana.

♦

Previously associated with Carnegie Illinois Steel Corp., Harvey McKenney has been made manager of alloy steel sales of Follansbee Steel Corp., Pittsburgh. William Heidgerd, who had been connected with Jones & Laughlin and United States Steel in sales capacities, has also joined Follansbee Steel Corp. as district manager for the Michigan territory with headquarters in the Stephenson building, Detroit.

♦

Ohio Crankshaft Co., Cleveland, has announced the following sales appointments: Strong, Carlisle & Hammond Co., Cleveland, covering the northern Ohio territory; Syracuse Supply Co., Syracuse, N. Y., covering New York state; William K. Stamets Co., Pittsburgh, for the western part of Pennsylvania, parts of Ohio and West Virginia; E. A. Kinsey Co., Cincinnati, for southern Ohio, southern Indiana, Tennessee and Kentucky; and R. R. Stephens Co., St. Louis, for southern Illinois, Missouri and adjoining territory.

♦

New appointments have been announced by General Alloys Co., Boston, in its sales organization. These are: J. B. McOwen, field metallurgical engineer for New York city, Long Island, northern New Jersey and eastern New York state territory; E. E. Whiteside, representative in northern Ohio and northwestern Pennsylvania area including West Virginia; Paul A. Ford, representative in Michigan; A. H. Valentine, the southern Ohio area; and R. W. Luzius in California and the Pacific Coast area.

MEETINGS AND EXPOSITIONS

Oct. 5-7—

National Safety Council. Meeting to be held at Sherman, LaSalle and Morrison hotels, Chicago. W. H. Cameron, 20 North Wacker drive, Chicago, is secretary.

Oct. 13-16—

Electrochemical Society. Meeting to be held at Hotel Pennsylvania, New York. Additional information may be obtained from C. G. Fink, Columbia university, New York.

Oct. 18-22—

American Society for Metals. Annual meeting to be held at Palmer House, Chicago, in conjunction with the twenty-fifth annual National Metal Congress. W. H. Eisenman, 7301 Euclid avenue, Cleveland 3, is national secretary.

Oct. 18-22—

Society of Motion Picture Engineers. Meeting to be held in Hollywood. Additional information may be obtained from Sylvan Harris, Hotel Pennsylvania, New York.

Oct. 18-23—

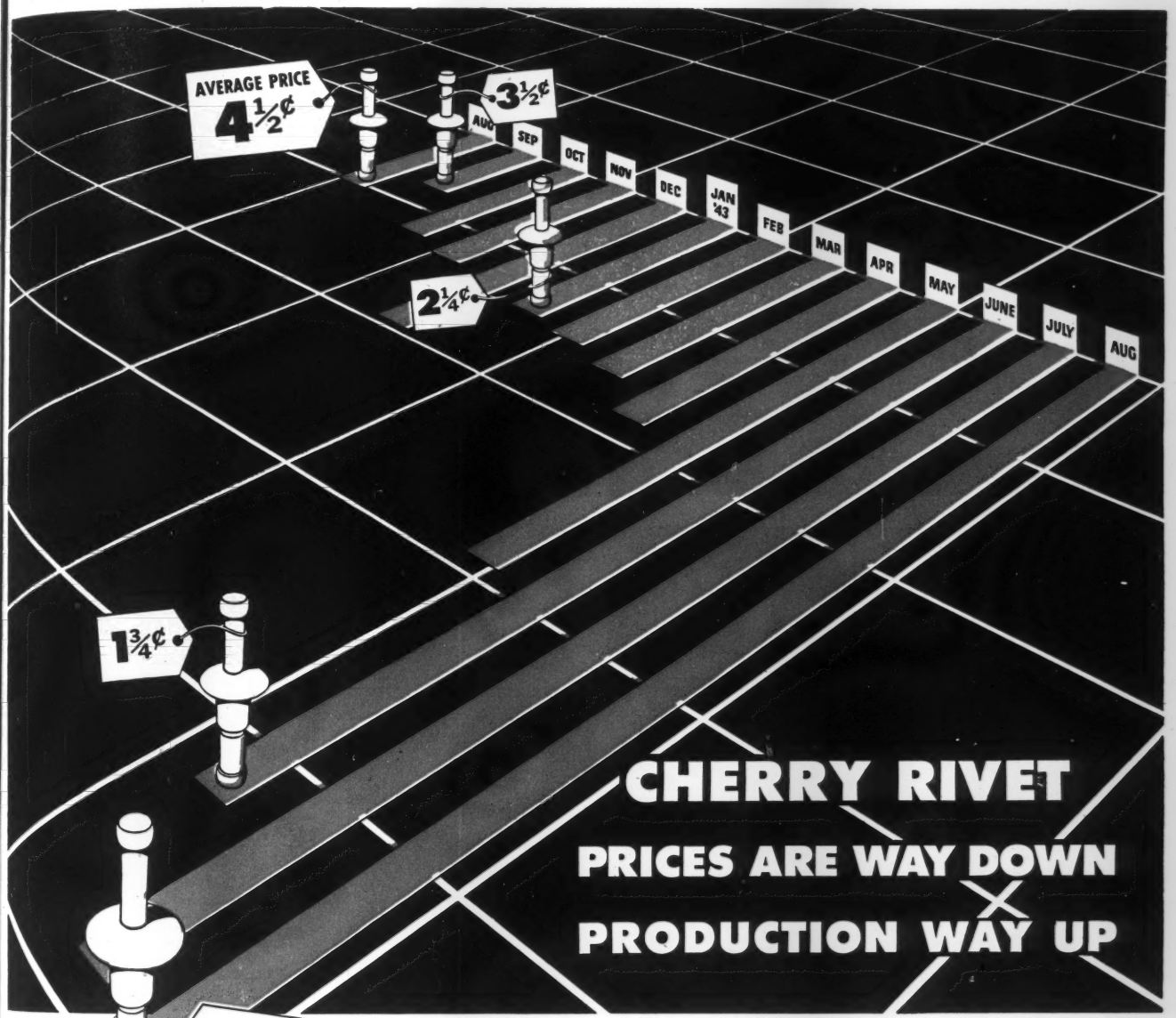
American Welding Society. Twenty-fourth annual meeting to be held at Hotel Morrison, Chicago. M. M. Kelly, 33 West Thirty-ninth street, New York, is secretary.

Oct. 25-27—

American Gear Manufacturers association. Fall meeting to be held at Edgewater Beach hotel, Chicago. Newbold C. Goin, Empire building, Pittsburgh, is executive secretary.

Oct. 25-29—

National Electric Manufacturers association. Annual meeting to be



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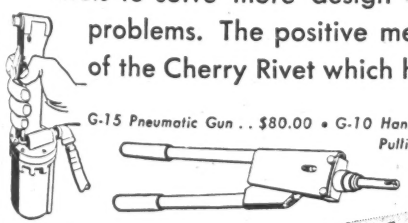

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